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ABSTRACT

This manual is intended to serve as a guide for those who are helping future Peace Corps volunteers to acquire basic food drying and storage skills. Included in the guide are lesson outlines and handouts for use in each of the 30 sessions of the course. Representative topics discussed in the individual sessions are scheduling, solar dryers, community assessment, food dryers and storage considerations, smoke tests, adult learning, natural cooling and rainy season drying, facilitation skills, nonformal education presentations, local development projects, independent study, pest control, and program evaluation. Each session outline includes a time estimate, objectives, a list of materials needed, handouts, trainer notes, and procedures for use in meeting the objectives of the course. Also included in the manual is a trainer's guide consisting of sample participants' notebooks, proposed 1- and 2-week schedules, a training program description, a list of recommended texts, a preprogram checklist, a materials and tools shopping list, and a sample certificate of completion. (MN)

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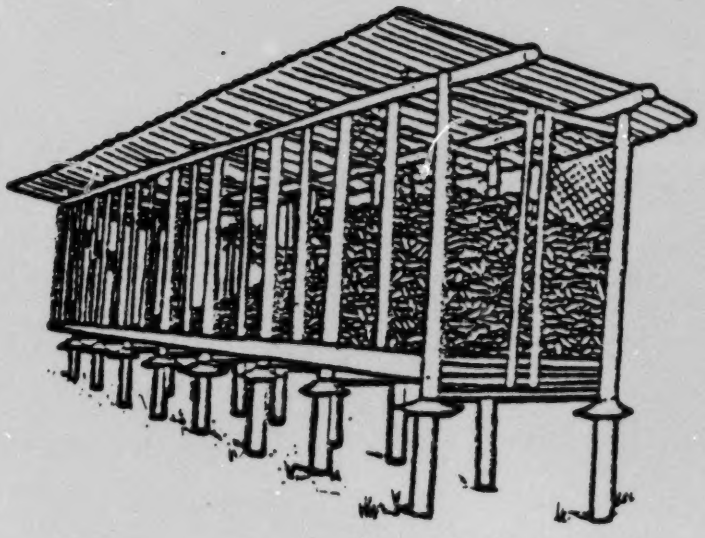

PEACE CORPS
OFFICE OF PROGRAM DEVELOPMENT
ENERGY SECTOR
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IMPROVED FOOD DRYING AND STORAGE

TRAINING MANUAL

U.S. PEACE CORPS

Prepared by Peter R. Zweig, Tom Gardiner and Charlotte Sommer;
CHP International, under contract No. PC 382-1013

FOREWORD

This training manual is the result of over three years of food drying and storage training programs given for the Peace Corps Energy Project. This final draft is the direct result of pilot testing the draft training manual during two (2) two-week training programs in Sierra Leone (January 17-February 4) and Kenya (February 14-25, 1983) under Peace Corps Contract PC 382-1013. It was also piloted as a one-week training program in Senegal (March 14-19, 1983) under a separate contract.

All of the pilot programs included Peace Corps Volunteers as well as Host Country Nationals, who played a very important role in the success of the programs. We strongly suggest that any future programs conducted using this training manual incorporate local people into the training program as participants: they will have much to learn from the program and will be vital sources of local information necessary for the success of the program.

We feel that this manual is another step in the process of developing useful, relevant training materials for technical and extension workers. Use this material as you need, to continue the process, and feel free to alter and improve each session.

If you have questions or comments about the manual, the training philosophy, or specific sessions of handouts, please contact us.

ACKNOWLEDGEMENTS

Many people have contributed to the development of this training manual over the years. Some of the technical and extension sessions and handouts have been adapted from the Farallones/CHP Appropriate Community Technology Training Manual, for which we owe a great deal of thanks.

Trainers who have helped us refine this training material over the years include John Morgan who participated as a trainer in four of the five Farallones Appropriate Technology Training Programs (during 1980-1982) as a solar food dryer trainer. Larry Jacobs helped with a training program in Togo, West Africa (in 1982) and offered many suggestions to help make the training more relevant to local needs. Tom Gardiner was one of the trainers in the first two pilot programs (1983) and made many valuable suggestions and changes before, during and after each program. Steve Joyce was a participant in the second and a trainer in the third pilot program (1983) and was thus able to make very useful comments and changes from a participant's and trainer's point of view. Heidi Schmidt participated in all three pilot programs (1983) providing insight, suggestions, encouragement and the excellent graphics work seen in some of the Handouts.

Peace Corps Washington Energy Sector provided encouragement in the persons of Ada Jo Mann, who coordinated the pilot programs and provided suggestions and improvements and Paul Jankura, the Program Manager, who was the impetus for the manual and participated in the third pilot program as a trainer, suggesting variations and improvements.

At CHP, we thank Howard Raik and Jim Kelly for their perspectives on training and development, Gail Gunderson for her meticulous typing, computer programming and general organizing and Brigitte Davis for her bookkeeping.

No list of acknowledgement would be complete without thanking all of the participants who have been part of the pilot programs and have offered their constructive criticisms of the manual.

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INTRODUCTION TO TRAINING

There are two threads running through this training program: one of technical training, in the areas of food drying and storage, and one of extension training, in the concept of appropriate technology community development

The main focus of the program, of course, is the technical training of Peace Corps Volunteers and their Counterparts, to be able to design, build, use and maintain improved food dryers and stores. But from an extension standpoint, the technologies themselves will not do anyone any good if they are not presented as community development tools. The community development philosophy that has been inherent in CHP/Farallones training programs over the years is one that takes people into account and builds on what they know to help them solve their own problems.

Technologies that do not take a people and their culture into account are doomed for failure and it does not take long to develop a list of improperly introduced technologies. But technologies that use locally available resources, both human and materials, to meet community-felt needs, have a good chance of succeeding and growing. Improving traditional technologies is more acceptable to a community than importing completely foreign ones. Technologies are only tools with which true community development work can proceed.

This training program is designed to model and parallel community extension work. Participants are asked to take a full and active role in their own education. They are urged to cooperate with others to identify and use the talents and resources that are available to the group and to practice skills that help motivate people, instill within them a feeling of self-confidence and involve them in the process of their own education.

The approach to training is based on the principles of non-formal education and is designed to strike a balance between structured learning and guided, yet independent discovery. The sessions, resources and methods that are included reflect the belief that people are capable of self-direction and creativity when encouraged to apply their knowledge and skills in ways that are relevant to their lives. It is the intent of the program to offer a framework to the participants to apply what they have learned in training to service in their own communities.

Introduction to Training

This program offers skill training in all stages of technical development: the design, construction operation, maintenance, evaluation and modification of prototype devices. The designs selected will be as consistent as possible with the realities of rural areas in most parts of the world and are based on the following criteria: affordable and low in capital investment, simple and adaptable in both design and scale, easily understood by people with little or no formal education, responsive to local needs and capabilities, able to be constructed, operated, maintained, repaired and managed by the users, based on the use of renewable sources of energy and local resources, both human and material and characterized by the potential to contribute to local cooperation, self-reliance and good health.

Throughout the program, there is a focus on the principles and techniques of non-formal education and adult learning, methods and approaches to solving problems, development issues, cross-cultural perspectives and the process of assessment and evaluation.

PARTICIPANT'S NOTEBOOK

It is a great help in the delivery of this training program to distribute, in the first session of the first day, a "Participant's Notebook", to everyone who will be taking part in the training. The notebok, itself, should be of the three-ring binder type, and should include the following, in order:

1. A Cover Page, listing the title of the program, the contract by which it is offered, the location and dates of the program and the name(s) of the trainers and/or contractor.

2. Table of Contents, listing all of the contents of the notebook, in order.

3. List of Handouts, listing all of the handouts enclosed, their handout number and title, in order.

4. Biography of the Trainer(s) mentioning name, job title, place of work, experience, travels or other interests and a background of the training program or reason why the training is being offered at this time.

5. The Handouts, include all of the handouts necessary for a successful training program.

6. Loose leaf paper or a notebook, on which to take notes or make drawings.

7. Textbooks, that are made available to the participants.

8. Pen and/or pencil.

PROPOSED TWO-WEEK SCHEDULE

The two-week schedule (included in the Handouts Section as Handout 1A) has gone through many changes and keeps getting better. You will, no doubt, want to or need to change it for your program. (If you need to give a one-week program, see the next section, "Proposed One-Week Schedule"). If you do change it, use Handout 1D, "Blank Two-Week Schedule"; replace the old Handout 1A with the new schedule and change the Handout numbers to match the new schedule.

A two-week program is strongly recommended over a one-week program. The two-week program is designed to:

1. flow smoothly, from beginning to end, with sessions building on the information gained in previous sessions and leading up to future sessions.

2. repeat the loading and unloading of solar dryers many times during the program, so that the participants will have the maximum opportunity to experiment with different devices, methods and procedures in a non-threatening atmosphere.

3. have indoor, classroom sessions in the morning and active, outdoor sessions every afternoon. This has evolved over years of workshops and has proven very successful.

4. combine technical and extension training, within the program and within sessions themselves. The technical training is focused in the first week, with extension being the focus of the second week. This follows from what the participants generally want: background, technical information first and then the ways and means to extend that information to others, using effective extension practice sessions.

5. let model design and construction preceed the actual design and construction, allowing participants to practice their small group skills, designing and building under time pressure and testing a model they think might work back home.

Proposed Two-Week Schedule

6. have practice sessions (19 and 21) naturally follow introductory sessions (18 and 20), allowing participants to experience a new technique and immediately apply this new information.

7. provide flexibility, scheduled into a seemingly structured program. Sessions 22, 23 and 24 might be continuations of Sessions 19 or 21, either at the training site or in a nearby village. Sessions 24 and 26 could be used to finish behind-schedule dryer or store, although this might want to be discouraged. The optional sessions can be scheduled in where and when deemed necessary by the participants and trainers. The Participant's Notebooks should already contain the Optional Session's Handouts.

8. end Friday at 6PM, although extra sessions could be scheduled for Saturday morning. The schedule allows people to travel back to their homes on Saturday instead of Sunday, which is often appreciated.

PROPOSED TRAINING PROGRAM SCHEDULE

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8	1) Introductions and Scheduling	4) Timeline	8) Adult Learning	12) Facilitation Skills	14) Economics	16) Other Technologies
10	2) Tour of Solar Dryers.	5) Design Considerations	9) Natural Cooling and Rainy Season Drying	13) Unload dryers	15) Storage Pests and Their Control	17) Mid-Program Evaluation
12						
2	3) Community Assessment	6) Smoke Tests 7) Model Design and Construction	10) Design of Dryers and Stores 11) Construction	11) Construction	11) Construction	(Optional Construction)
4						
6						

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8	18) Introduction to Non-Formal Education	20) Introduction to Method Demonstrations	22) Local Development Projects	24) Chemical and Non-Chemical Pest Control	27) Program Evaluation	
10	19) Non-Formal Education Presentations	21) Practicing Method Demonstrations	23) Independent Study	25) Action Plan	28) Preparation of Presentations	
12						
2	13) Unload, reload	13) Unload, reload	13) Unload, reload	13) Unload, reload	29) Presentation of Devices	
4	11) Construction	11) Construction	11) Construction	26) Assessment and Modifications		
6					30) Wrap-up	

PROPOSED ONE-WEEK SCHEDULE

The one-week schedule which follows is the schedule that was used in Senegal. We do not recommend a one week training program because of all of the material that has to be briefly covered of completely left out.

The schedule that follows is a "pared-down" version of the two-week schedule, with these changes:

1. The model designing and construction is eliminated. This means that people don't have a chance to try a new or different design, but will more likely decide on a less-risky, assured design.

2. Extension sessions are all but eliminated. Those that do take place seemed rushed and there is little time to discuss the combining of technical and extension skills.

3. Construction time is limited, which tends to make people design and build extremely simple devices that never seem "real" to them; they have little time or energy invested in their devices.

4. There is no repetition of the loading and unloading of dryers. People have one, and maybe two chances to prepare different foods in different ways, or use different devices.

5. The mid-program evaluation does not have much to look back on and leaves little time to make changes in the remainder of the program.

6. Optional sessions have to be scheduled in the evenings, which reduced motivation and tires people more quickly. It is harder on the trainers, as well as the participants.

PROPOSED TRAINING PROGRAM SCHEDULE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1. Introductions and Scheduling	5. Design considerations	15. Storage Pests and their control	17. Mid-Program Evaluation 18. Introduction to Non-Formal Education	14. Economics 9. Natural Cooling and Rainy Season Drying	29. Presentation of Devices
2. Tour of Solar Dryers	10. Design of Dryers and Stores	11. Construction	13. Unload Dryers	25. Action Plan	27. Program Evaluation
6. Smoke Tests 3. Community Assessment 4. Timeline	11. Construction	11. Construction	11. Construction	28. Preparation of Presentations	

DESCRIPTION OF TRAINING PROGRAM

This Description of Training Program is a concise outline of the proposed training program in improved food drying and storage. It can be used in a number of ways:

1. It can be sent to prospective Peace Corps Directors or Associate Directors in whose country such a training would meet a community-felt need.

2. It can be sent to the program manager or logistics coordinator who is in charge of organizing the workshop and/or purchasing materials and tools.

3. It can be sent to other trainers to brief them on the timing and content of the training program and to point out those areas in which assistant trainers could take part.

4. It can be sent to Peace Corps Volunteers who would like more information on the program.

5. It can be sent to local people, who may be interested in taking the program and would like more information.

Description of Training Program

The Improved Food Drying and Storage Training Program that is offered includes both theoretical (classroom) and practical (hands-on) experience in the technical and extension skills necessary to successfully design and build devices and introduce them to local people. The following catagories detail the proposed program:

1. Timing

   A. The program is designed to be delivered in two weeks and this is strongly suggested. However, the program can be reduced to a one-week program with a considerable reduction in the quality of the training material.

   B. The program is designed to be presented eight hours per day, Monday through Friday, and four hours on Saturday (the proposed schedule is available for your perusal).

   C. Sessions are designed to be pesented in two- and four-hour blocks of time, specifically, 8AM to Noon, and 2PM to 6PM. Evening sessions are possible, but not recommended.

   D. The program is approximately one-third technical, one-third hands-on and one-third extension.

2. The Technical Component includes the following:

   A. The advantages and disadvantages of traditional drying and storage

   B. Design considerations for dryers and stores

   C. Design, construction, testing and modification of dryers and stores

   D. The safe application of insecticides

   E. Identification and control of storage pests

Training Description

F. Design information on natural cooling and rainy-season drying

G. Information on "other technologies" as suggested by the participants

3. The Extension Component includes the following:

A. Adult learning theory and methodology

B. Non-Formal education theory and practice

C. Effective techniques for the introduction of new technologies to non-formally educated people

D. Community Assessment methods and practice

E. Method demonstrations

4. Optional Sessions (offered in plce of or in additon to other sessions) include:

A. Technical dryer design information

B. Solar siting

C. Preparation of fruits and vegetables for drying

D. The use of dried foods

E. Problem-solving skills

Descriptive Bibliography of Solar Dryers and Storage Devices

A. Solar Dryers

1. A Survey of Solar Agricultural Dryers - Report T99, Dec. 1975.

   This Survey contains the history, use, plans and drawings of solar dryers from throughout the world. Locally designed and built dryers are of special interest. Full of technical data and useful drawings and plans.

2. Preserving Food by Drying. A Math/Science Teaching Manual (Manual #M-10)

   A very good teaching manual for people involved in education at the junior high or high school level. Describes the physics of solar energy design and the physiology of dryed foods, health and nutrition.

3. Proceedings of the Solar Dryer Workshop, Manila, Philippines, 1978.

   Focus of this book is the drying of foods in humid tropical regions of the world. More technical, less practical.

B. Drying and Storage

1. Postharvest Food Losses in Developing Countries.

   An excellent book describing food losses and how to control them. Complete with photographs of improved storage devices from around the world. Focus on using low-cost improvements which utilize local materials and resources.

2. Small Farm Grain Storage

   A complete manual on solar dryers, back-up heaters, improved storage devices, and enemies of stored grain. Good information on control of insects and rodents. Full of clear drawings, charts, and plans.

3. Village Technology in Eastern Africa

   Focus on improving health and nutrition of women and children through the use of appropriate technologies. Short section on solar dryers and improved food storage devices.

C. Grain Storage

1. Appropriate Technology for Grain Storage

   Report of one village dealing with their food storage problems in 8 weeks using the dialogue approach to community development. Focus on improving local grain storage techniques using simple, low-cost, locally designed and built devices.

2. Programming and Training for Small Farm Grain Storage

Complements Small Farm Grain Storage, with focus on methods of taking that information to farms and rural areas.

3. Handling and Storage of Food Grains in Tropical and Subtropical Areas #12, Hall, D.W., 1975, 2nd Ed., Food and Agricultural Organization of the United Nations, Rome, ITALY

An excellent, detailed and highly technical handbook on storage of food grains, from small-scale to large scale. Full of useful information for trainers, agriculturalists and extension workers.

PRE-PROGRAM CHECKLIST

Before you depart the U.S.:

- Establish contact with Peace Corps/Washington and become familiar with what communication there has been with the country in which the training will take place.
- Modify the "Description of Training" as much as you feel necessary and distribute it with an introductory cover letter to the appropriate people.
- Coordinate travel plans with Peace Corps schedules, and be sure arrival date and time are communicated to the country.
- Complete travel related preparations in a timely fashion: obtain visas, vaccinations and WHO card up-date, medications for suggested possible illnesses.
- Prepare the Participant's Notebooks, even if you are not sure yet of all of the specific handouts you will be using, as in-country facilities may not be readily available for such quantities.
- Identify and order text materials.

In-Country:

- Conduct a pre-training needs assessment, including a village visit.
- Arrange for locally available building materials to be made (i.e., mud blocks, baskets, woven mats, etc.) and collected (i.e., bush poles, bamboo, etc.) as soon after your arrival as possible as some may take some time (such as 3 day drying time for mud blocks).
- Meet with Peace Corps staff who are involved in this program, to discuss their and participants' expectations.
- Meet with training staff (trainers, support staff, training assistants, site logistics/administrative personnel) to discuss the program and clarify roles and responsibilities for each.

MATERIALS AND TOOLS SHOPPING LIST

Materials	Size, description	Number to buy
Mudblocks	15cm x 15cm x 30cm	200-300
Cement, 50kg bag	50 kg bags	3-5
Sand	cubic yards	1
Gravel	cubic yards	1
Clay	cubic yards, dry	1
Chicken wire	galvanized, 1cm holes 1m x 25m roll	1
Plastic Sheet	clear, polyethylene or vinyl, 2m x 25m	1
Window screen	fiberglass or nylon (not metal) 1m x 15m	1
Mosquito Netting	nylon, not cloth 2m x 25m	1
Wire, thin	18-26 gauge, 30m total	1
Twine, 2-3mm	2-3mm diameter, locally made, 100m	1
Bush Rope	4-6mm diameter, local 50m	1
Nails: 3cm long, kilograms		1-3
5cm long, kilograms		1-3
8cm long, kilograms		1-3
Paint, black	flat or matte, liters	1-2
Paint, white	gloss, exterior	1-2
Corrugated metal roofing	galvanized, 75cm x 2m	8 sheets
Corrugated Fiberglass roofing	clear, 75cm x 2m	3 sheets
Lumber: 1" x 6" x 10m total length (in 3-4m lengths)		1
2" x 2" x 20m total length		1
Large baskets for food storage, 1 cubic meter size		3
Woven mats approx. 2m x 20m TOTAL (found in pieces)		1
Bush poles 4-6 cm diameter, 3m long		80
Bamboo poles 4-6 cm diameter, 3m long		20
Reeds 1-2 cm diameter, 1m long		100
Calabashes various sizes, with tapered neck, whole		5
Large Tins, 20 liter, empty		5
Salt, fine, dry, kilogram		1/2
1% Malathion Dust insecticide, kilogram		1/2
FRUITS & VEGETABLES: various types, as available, FRESH (See Sessions 2 and 13)		
Cardboard boxes, approx. 1/2 cubic meter size, strong		10

Tools

Shovels pointed for digging	3
Saws, crosscut and rip, each	2
Hammers, 1/2kg claw (for hammering and pulling nails)	4
Pliers, medium length, 15-20cm	3
Tin Snips, 30cm	2
Trowels, diamond-shaped, masonry, 20cm length blade	3
Paint Brushes, inexpensive, 5-10cm wide	3
Buckets, either metal or plastic, 10 liter size	3
Wood chisels, 1cm, 2cm, 3cm each	1
Tape measures, 2 meter length	4
Files for sharpening machetes and tools, 20-30cm length	1
Thermometers, 3-5cm dia. dial-type preferred, for air	6
Paring Knives, 9cm - 12cm blade, inexpensive	10
Bubble Levels, for masonry work, 30cm-40cm	2
Machetes or local big knives, sharp	6

CERTIFICATE OF COMPLETION

This Certifies That

_____

Has Successfully Completed

The Peace Corps In-Service

Food Drying and Storage Workshop

_____ _____

Project Director Trainer

_____ _____

Trainer Trainer

SESSION #1 **INTRODUCTION AND SCHEDULING**

TOTAL TIME: 2 Hours (the first sesion of the program)

OBJECTIVES: By interviewing each other and introducing each other to the group, the participants will gain interviewing and speaking skills.

By identifying the skills and resources in the group and posting the written interviews, the participants will gain recognition of the information that they bring into the training program.

By describing their personal expectations of the program and the expectations that their communities have of them, the participants will better understand whether or not their expectations will be met by the program.

By reviewing the proposed schedule and sessions with the trainers and making necessary changes, the participants will understand how their expectations can be met and the flexibility of the trainers.

By reviewing the Introduction to Training, the participants will understand the parallels between this training program and community development work.

MATERIALS: Newsprint and markers, masking tape and for each participant, "Participant's Notebook" containing: a table of contents, the list of handouts, the biographies of the trainers, the handouts for each session, notebook paper, pen and/or pencil and text(s) (as available).

RESOURCES:
Handout 1A: Proposed Training Program Schedule
Handout 1B: Session Descriptions
Handout 1C: Introduction to Training
Handout 1D: Blank Two-Week Schedule

Trainer Note

Prepare the room by arranging a sufficient number of chairs in a circle or semi-circle. Post the objectives and the session procedures. Have a sufficient number of pieces of lined paper or newsprint, markers or pens for the interviewing step, enough pieces of tape to post each piece of paper or newsprint and one "Participant's Notebook" for everyone in the room (see Trainers' Guide for details). Prepare the questions listed in Step 10.

PROCEDURES:

Step 1: 5 minutes
Welcome everyone to the training. Explain the reasons for this session, its objectives and procedures.

Trainer Note

This first activity of the first session will set the mood for the program so be relaxed, flexible, accepting, non-authoritarian and in a good humor.

Ask if everyone in the group knows each other. If they do, this session can be shortened considerably by quickly going through steps 2,3,4 and 5, which will allow more time for expectations and scheduling. Stress the importance of introductions at the beginning of any program and the identification of local resources and skills.

Step 2: 10 minutes
Post a blank piece of newsprint at the front of the room, head it "Interview Questions" and ask the group to list the questions they would like to have shared with the group.

Trainer Note

The list should include: Name, home, work, skills or experience in: food drying, food storage, contruction, education, extension and language, plus personal expectations of the program and expectations that your community members have of your during this program. You may want to prepare this list before the session, post it and review it here.

Step 3: 20 minutes
Form small groups, interview each other and write down the answers to the interview questions.

Trainer Note

If the group has less than 20 people in it, these groups can be pairs and the answers can be written on notebook paper. If the group is larger than 20, form small groups of 4 or 5, have one person record the answers for the entire group on one sheet of newsprint, then have one person introduce the entire small group to the large group, to save time. Writing the names and other informaton on newsprint makes it easier to match names with faces. Have people interview people they don't already know. Remind the groups of the time to keep from going too long.

Step 4: 20 minutes
Have people introduce each other to the group.

Trainer Note

With pairs, have each person introduce their new friend. With larger groups, have one person introduce the group. Have people stand as they are introduced. Be sure each interview question is answered for each person. Point out the large number of people in the room who bring skills and resources to the group.

Step 5: 5 minutes
Post the answers to the interview questions around the room.

Trainer Note

Remind people to read over the posted answers to better identify local resources.

Step 6: 10 minutes
List and review the expectations of the group. Explain which will be met by the proposed training schedule, which can be met with some schedule changes and which will not be able to be met.

Step 7: 5 minutes
Distribute the Participant's Notebooks, texts and pens.

Step 8: 20 minutes
Have everyone read the Biographies of the Trainers and answer any questions they may have. Have everyone review Handouts 1A and 1B, "Proposed Training Program Schedule" and "Session Descriptions".

Trainer Note

If it is necessary to add or subtract some sessions, include some of the optional sessions or change the proposed schedule to meet the expectations of the participants, do it at this time for the first week, filling in the "Blank Two-Week Schedule", Handout 1D as necessary.

Take the following suggestions into account when rescheduling: balance classroom and outdoor sessions, note weather patterns (morning clouds, afternoon showers, etc.) when scheduling outdoor sessions, try to follow the chronological order of the sessions as listed in Handout 1B. Remind everyone that the schedule for the second week of training can be made or changed during Session 17, the Mid-Program Evaluation.

Step 9: 15 minutes
Have everyone read Handout 1C, "Introduction to Training" and answer any questions.

Trainer Note

Explain that Handout 1C describes the training program philosophy, which may be different than the philosophies (if any) of training programs in the past. Point out the parallels between this training program and effective community development work.

Step 10: 10 minutes

Conclude the session by asking, "Did any of your expectations change during this session? Did the schedule present something that you were not expecting during training? Is there anything that you've heard about the training that hasn't been discussed? and Have the objectives of the session been met?"

Trainer Note

It is helpful if these questions are written and posted in the front of the room. If there is little or no response, end the session by reminding everyone to bring their notebooks with them to each session. Encourage them to read upcoming handouts and the texts.

SESSION #2 **TOUR OF SOLAR DRYERS**

TOTAL TIME: 2 Hours (this session is best done early in the morning of a warm, sunny day for optimum drying and dryer performance.)

OBJECTIVES: By discussing the advantages and disadvantages of several different dryers, noting their air flow and temperature differences and by taking notes, participants will be able to compare and contrast the different dryers for effectiveness.

By preparing various locally available foods for drying participants will begin to understand the issues of proper food preparation and the variations of preparing different foods. By using foods of various stages of ripeness, participants will understand the relationship of the level of ripeness to good drying.

MATERIALS: At least two solar dryers (more, if possible), simple smoke source (such as a bee smoker or less expensive equivalent), variety of fresh or rehydrated foods*, partially and fully dried foods*, soap and water, clean cutting surfaces (cardboard or wood), paring knives, thermometers (C or F), notebooks or paper, pens or pencils.

* food should be various locally available maize, rice, other grains; legumes; fish; fruits and vegetables

RESOURCES: Handout 2A "Tips for Drying"
Handout 2B "Data Collection Sheets"
Small Farm Grain Storage
Survey of Agricultural Dryers
Procedings of the Solar Dryer Workshop, Philippines

Trainer Note

This session may require sustantial preparation since at least two dryers are needed to demonstrate, compare and contrast. These dryers may have to be built or repaired prior to this session. (Refer to Handout 5A "A Catalog of Dryers and Stores".) Prepare a traditional dryer, a slightly improved dryer and a "high-tech" dryer for the purposes of comparison.

If the available dryers are small, orient them prior to the session so that they will be collecting solar energy and air will be circulating through them during the tour.

Trainer Note (Continued)

Put samples of fresh or rehydrated fruits, vegetables, grains and legumes into the dryers one or two days prior to the session so that the participants can see and taste partially dried foods.

If time permits and you feel the training should seriously address food storage, then one or two improved stores (from Handout 5A) should be built and included in the tour.

PROCEDURES:

Step 1: 5 minutes
Review objectives and post session procedures.

Step 2: 5 minutes
Refer to Handouts 2A and 2B, "Tips for Drying" and "Data Collection Sheets". Read and discuss.

Trainer Note

Encourage everyone to take notes on types of food, degree of ripeness, method of preparation, etc. The more information that is written down on the "Data Collection Sheets" the easier future sessions will be.

Step 3: 50 minutes
Have the whole group tour dryers, discuss and critique each, check temperature, taste dried foods and conduct smoke test.

Trainer Note

During the tour of dryers, ask these questions:

What is this?
How do you think it works?
Do you think it will work well?
How much would this cost to build in your village?
How could it be built for less?
Is this big enough for an average-sized family?
If not, how big would one have to be?

Trainer Note (Continued)

If applicable: What is the temperature inside?
Is this too high or too low?

Any questions?

Remove and taste dried and partially dried foods.

If it is a sunny day, light the smoker and introduce smoke into the inlet vent of the enclosed dryers to demonstrate the air flow rate and pattern.

If there is a sufficient number of trainers, post one trainer at each device and have small groups of participants circulate from one device to another. Distribute the list of questions to each trainer, prior to this step.

Step 4: 50 minutes
Have the participants prepare their foods for drying, record information on the "Data Collection Sheets" and load the dryers.

Trainer Note

Refer to Handout 2A "Tips for Drying" and answer questions.

Step 5: 10 minutes
Have the participants clean up and put away the equipment used during the session and properly dispose of the food waste.

SESSION #3 **COMMUNITY ASSESSMENT**

TOTAL TIME: 4 Hours

OBJECTIVES: By developing a list of community assessment questions, participants will discuss the importance and content of community assessment and how it relates to appropriate dryer and storage design and community development work.

By performing a community assessment, the participants will practice information gathering which will be helpful in future community work.

By compiling information into a report, participants will develop filtering and organizing skills, which will be helpful in future work.

By discussing the parallels between the training program and effective community development work, the participants will better understand the background of the training and possible directions for work in their own communities.

MATERIALS: Flipchart and markers, notebooks and pens

RESOURCES: Handout 3A "Food Drying and Storage Community Assessment Questions"
Handout 3B "Guidelines for Community Assessment"

Trainer Note

The timing of this outdoor session should take the weather into account. If there is a lack of nearby villages, arrange for the transportation of the participants to villages for this session, using the training site vehicle(s) or local taxis. Some participants may choose to interview their local counterpart at this time instead of performing a community assessment near the training site.

PROCEDURES:

Step 1: 5 minutes
Review objectives and post the session schedule.

Step 2: 5 minutes
Discuss and clarify reason for community assessment.

Trainer Note

Ask for a participant to briefly clarify the reason for the assessment and how it relates to development work.

Step 3: 20 minutes
Develop a list of community assessment questions, topics, issues, etc. that participants will need to know before a dryer or storage device can be designed. Refer participants to Handout 3A "Food Drying and Storage Community Assessment Questions" and complete the handout with the questions listed in this step.

Step 4: 5 minutes
Form assessment teams by interest, locality, foods, etc. Have participants read Handout 3B "Guidelines for Community Assessment" and discuss.

Trainer Note

Remind everyone of the time the session will reconvene (i.e., 5PM). Be sure at least one person in each group has a timepiece.

Step 5: 2 hours 30 minutes
Conduct assessment of community in small groups and record findings.

Step 6: 50 minutes
Reconvene large group and have small groups give reports of findings of community assessment. Discuss findings.

Trainer Note

Allow time for each group to thoroughly report their findings. Discuss each report after it has been given. Discuss overall findings at the end of last report. Remind reporters that it is not necessary to repeat information already reported. Keep the reports moving.

Step 7: 5 minutes
In the large group, discuss how findings relate to dryer and storage design, parallels between community development work and appropriate dryer/storage design methodology.

Trainer Note

Ask if there is a felt need for improved dryers or storage devices.

Ask if preconceived dryer/storage designs have changed because of the community assessment. Ask if anyone has developed the "ultimate appropriate food dryer or storage device" because of the assessment.

SESSION #4 **DRYER AND STORAGE TIME LINE**

TOTAL TIME: 2 Hours

OBJECTIVES: By generating timelines showing harvest times, dry seasons, wet seasons, market prices of foods, planting times, humidity, temperatures, etc. the participants will understand the relationships between drying and storage, solar dryers and rainy season dryers, harvests and dryer programs, economics of storing food versus buying food, etc.

MATERIALS: Flipchart and markers, notebooks and pens, masking tape.

RESOURCES: HANDOUT 4A, "Sample Food Drying and Storage Timeline"
Local people (someone with complete knowledge of climate, crops, costs, etc), written material or second-year Volunteers.

PROCEDURES:

Step 1: 5 minutes
Review outline and note procedures.

Step 2: 15 minutes
Present a blank timeline to the group and help the group generate a list of information to be considered for the timeline.

Trainer Note

Refer back to Session 3, "Community Assessment". The list should include, but not be limited, to: crop availability (types of crops, harvest times, planting time), sun availability (dry, wet, cloudy seasons), food costs (highs, lows, supply and demand), local food use (seed, home use, sale, storage, barter, etc.), humidity, temperature, etc.

Step 3: 30 minutes
Have small groups develop a timeline for their specific region.

Trainer Note

Refer the participants to Handout 4A, "Sample Food Drying and Storage Timeline". Identify and list all of the different climate areas of the country. Identify those participants who are from each climate area and have them form a small group to develop a drying and storage timeline for their specific area.

Step 4: 1 hour
Have each small group present their timeline. Discuss each timeline after it is presented.

Trainer Note

Facilitate the presentations and discussion.

Step 5: 10 minutes
Conclude the session by pointing out the differences of the climate areas in the country and how the timeline can be used in future sessions (Design Considerations, Natural Cooling and Rainy Season Drying, Design, and Construction.)

SESSION #5 FOOD DRYER AND STORAGE CONSIDERATIONS

TOTAL TIME: 2 Hours

OBJECTIVES: By listing and discussing traditional drying and storage methods and procedures, their advantages, problems associated with them and some solutions to those problems, the participants will share their local knowledge and begin to develop a list of dryer and storage design considerations.

By reviewing a catalog of dryers and stores, watching a slide show of dryers and stores from around the world and discussing them, the participants will get an overview of the range of devices and materials that can be used to solve drying and storage problems in their own community.

MATERIALS: Newsprint, markers, slide projector, screen, masking tape.

RESOURCES: Handout 5A "A Catalog of Dryers and Stores"
Handout 5B "Food Drying Considerations"
Handout 5C "Food Storage Considerations"
The Farallones Institute Dryer and Storage Slide Show
Community Assessment Reports (from Session #3)
Appropriate Technology for Grain Storage, pp. 33-40, 41-52
Post Harvest Food Losses in Developing Countries, pp. 51-63, 71-2, 77-82, 86-90
Small Farm Grain Storage, Part 7, pp. 1-150

PROCEDURES:

Step 1: 5 minutes
Post and review the steps of the session.

Step 2: 20 minutes
In small groups, list and discuss the following: Traditional drying and storage methods, advantages of the traditional methods, problems associated with traditional methods and solutions to those problems.

Trainer Note

Refer the participants to Session #3, "Community Assessment". Refer to Handout 5A "A Catalog of Dryers and Stores" to help people describe traditional methods of drying and storage. Distribute newsprint and marker to each group and have them record their lists.

Step 3: 40 minutes
Reconvene the large group and have one person from each small group present the information generated. Discuss and clarify each presentation.

Trainer Note

Facilitate the presentations. Remind reporters that there is no need to repeat information presented previously. Point out the similarities and differences between the reports.

Step 4: 20 minutes
Refer to the session's handouts. Read and discuss them. Answer questions.

Trainer Note

Ask people to identify local drying and storage techniques from the catalog. Ask if any "improved devices" have been built in the country. Point out the similarities between the solutions reported by the group and the considerations listed in the handouts.

Step 5: 20 minutes
Show the slides and discuss.

Trainer Note

This step is meant to quickly introduce the participants to a number of different dryers and stores from around the world and not dwell on any design details of any specific dryer or store. Therefore, move quickly through the slides, pointing out the main focus of each slide. (Offer to show the slides again, more slowly, in the evening or at lunchtime, if there is an interest.)

Step 6: 5 minutes
Conclude the session by applying the information shared during the session to the training program (Sessions 6,7,10 and 11) and community work after the program.

Trainer Note

Refer the participants to the Resources, especially to the selected pages of "Appropriate Technology for Grain Storage", for a detailed description of helping a community solve their own storage problems.

SESSION #6 **SMOKE TESTS**

TOTAL TIME: 1 Hour

OBJECTIVES: By performing and analyzing "solar chimney experiments", the participants will better understand the relationships between the color, tilt, orientation, height, air flow and temperature of various solar dryer models.

MATERIALS: Stovepipe, paint, paint brushes, paint cleaner (necessary for oil-based paints only), smoke source (such as beesmoker or less expensive equivalent), thermometers and tape measures.

RESOURCES: Handout 6A "Smoke Test Data Collection Sheet"

Trainer Note

Obtain enough stovepipe so that each small group of 2 or 3 will have about three sections of stovepipe to experiment with. Groups will be able to exchange stovepipe for expanded experiments. The stovepipe should be of several different diameters (6, 10 and 15cm diameter, for example). Paint some of the stovepipe with flat black paint and some with white paint, prior to this session, to allow time to dry. It's okay to paint one side (not one end) of a piece of stovepipe black and the other side white, since only one side can face the sun at a time. Leave some pieces of stovepipe their original color.

Prepare the list of questions in Step 1.

PROCEDURES:

Step 1: 10 minutes
Introduce the session and post the procedures.
Post these questions and review:
What is the relationship between:
1) color and temperature
2) vent area and temperature
3) orientation and temperature
4) vent area and air flow
5) height and air flow
6) tilt and air flow
7) air flow and temperature

Refer to Handout 6A, "Smoke Test Data Collection Sheet".

Trainer Note

Introduce this session by referring to past session (2 and 5) and recalling that optimal drying conditions require that food be exposed to warm, moving air. Explain that the handout is set up to help identify the differences in air flow and temperature of different "solar dryer models or chimneys". Explain that people who already know all the relationships can help those who don't or who have a math anxiety.

Step 2: 30 minutes
Form groups of 2 or 3, perform the experiments, take data and find the relationships listed.

Trainer Note

Remind the groups that they can exchange pieces of stovepipe. Be sure there is at least one thermometer, one smoke source and one tape measure for each small group. Suggest each group have one recorder who is responsible for taking data and one calculator who can do all the calculations.

Step 3: 20 minutes
Reconvene the large group to answer the questions posted in Step 1.

Trainer Note

Facilitate the reporting of the data. Begin by asking, "Who got the highest air flow? (from Column I) Under what conditions? Who got the highest temperature? Under what conditions? Who got the highest air flow AND the highest temperature in the same experiment? Under what conditions?" Then move to the questions listed in Step 1 and describe the relationships.

Remind everyone that a fast time (Column H) does not necessarily mean a high air flow (Column I) because the volume of the chimney (Column G) plays an important role.

Point out the applications of this session to solar dryer design and construction (the aim is to have a high air flow with an optimal temperature [see Handout 13B] while keeping the construction low-cost and simple.)

Remind everyone of the following sessions (7, 9, 10 and 11) in which the information from this session will be used.

SESSION #7 **MODEL DESIGN AND CONSTRUCTION**

TOTAL TIME: 3 Hours

OBJECTIVES: By using new information to quickly build a model of a solar dryer or storage device, the participants will gain experience on which to base future decisions.

By explaining their model to others for critiquing, participants will begin to formulate questions of their devices to be answered in future sessions.

By working on a project in small groups, in a short period of time, and processing it, participants will begin to develop group and problem solving skills.

MATERIALS: cardboard, screen, small pieces of bamboo and wood, black paint, tinsnips, saws, hammers, wire, clear plastic, sheet metal, paint brushes, paint thinner, nails, strong tape, glue, beesmoker, smoker fuel, matches, thermometers, gourds, wax, cloth, jars, string.

RESOURCES: Handout 7A "Effective Group Survey"
Handout 7B "The Decision-Making Process"
Handout 7C "Feedback and the Helping Relationship"
Assorted dryer and storage plans and resources such as:
Handout 5A "A Catalog of Dryers and Stores"
"Brace Research Institute Dryer Survey"
"Preserving Food by Drying"
"Procedings of Solar Dryer Workshop, Manilla"
"Drying Foods in the Tropics"
"Grain Storage for the Ghanaian Farmer"
"Post Harvest Food Losses in Developing Countries"
"Small Farm Grain Storage"

PROCEDURES:

Step 1: 5 minutes
Review objectives and post the procedures.

Trainer Note

List tools and materials available to the participants. Stress the construction of models, as opposed to full-scale units. Point out the time limitations.

Step 2: 2 hours
Form work groups; design and build a model of a solar dryer or storage device.

Trainer Note

Circulate among the groups, reminding them of the time. Help people find the tools and materials needed. Remind the groups that the models don't necessarily have to be technically correct (because they will have a chance to improve on this design) but the design should be useful as a demonstration.

Step 3: 5 minutes
Generate and post a list of "Evaluation Criteria" to be used to critique each model as it is presented.

Trainer Note

The list should include: low-cost, uses local materials, simple, effective, appropriate, understandable, technically sound, etc.

Step 4: 30 minutes
Tour the models with each group describing its device.

Trainer Note

Facilitate the tour, keep it moving, ask each group to describe their device, their original plans and how the plans changed during construction. Ask for questions from the group. Ask the group to evaluate each model, using the criteria listed in step 3.

At the end of the presentations, remind the participants that they can either improve the design used during this session or use a completely different design for the longer construction session.

Step 5: 10 minutes
Refer everyone to Handout 7A, "Effective Group Survey", and have them answer each question.

Trainer Note

Encourage everyone to share their answers with the other members of their small group. Refer people to Handout 7B, "The Decision-Making Process", which describes some types of decision-making.

Encourage people to read Handout 7B and Handout 7C, "Feedback and the Helping Relationship", because they can be useful during this program and beyond.

Step 6: 10 minutes
Clean up the work area.

SESSION 8 **INTRODUCTION TO ADULT LEARNING**

TOTAL TIME: 2 hours

OBJECTIVES: By describing how they best learn, the participants will understand the adult learning loop and how it is being used during training.

By reading and discussing articles on non-formal education, the participants will be able to decide if these techniques are usable in-country.

MATERIALS: Flipchart, markers, notebooks, pens, masking tape

RESOURCES: Handout 8A "Non-Formal Adult Education", Srinivasan
Handout 8B "Extension, Training and Dialog", DeVries

PROCEDURES:

Step 1: 5 minutes
Review the objectives and post the procedures.

Step 2: 5 minutes
Have everyone list the steps, they took as an adult, to learn something effectively.

Trainer Note

Have each participant think back (reflect) on a skill that they feel was well-learned. Have everyone list, in order, the steps they went through to learn this skill.

Step 3: 20 minutes
Have each participant describe their list to the group.

Step 4: 20 minutes
Draw the experiential/adult learning loop on the board/flipchart and point out that just about everyone's list fits the loop.

Trainer Note

Use the words of the group to mark the points of the loop. Ask for different people to show how their list fits the loop. Show the parts of the loop (experience or activity) that correspond to "experimentation" or "action" and those parts (reflection or processing, generalizing or filtering; and application or looking ahead) that comprise the "reflection" or "thinking" part of learning. Show how one is useless without the other, give examples (formal schooling, "work", theoretical sessions, etc.).

Ask for some examples of how the loop has been used within or during training sessions.

Ask if it has been effective and how people feel about it.

Step 5: 50 minutes
Refer to Handout 8A, "Non-Formal Adult Education", and Handout 8B, "Extension, Training and Dialog". Have everyone read them and discuss the applicability of non-formal education in-country.

Trainer Note

Ask what participants thought about the articles. Ask if anyone has tried non-formal education in-country. Ask where and how non-formal education is applicable in-country. Ask which of the 8 assumptions of non-formal education (Handout 8A, p.5) are valid for the country? Why? Why not?

Step 6: 15 minutes
Refer back to the first session, the Introduction to the Manual and the articles read today to reflect on adult learning in the program. Refer to future non-formal education sessions (facilitation skills, non-formal education activities, practicing, etc.) in which people can apply adult learning.

SESSION #9 **NATURAL COOLING AND RAINY SEASON DRYING**

TOTAL TIME: 2 Hours

OBJECTIVES: By discussing traditional and improved natural cooling and rainy season dryer devices, the participants will better understand their applications and be able to design and build such a device in up-coming sessions.

MATERIALS: Newsprint, markers, notebooks, pens, masking tape

RESOURCES: Handout 5A "A Catolog of Dryers and Stores"
Small Farm Grain Storage Parts 2 and 5
Design and Construction of an Evaporative Cooler, Jankura, P. C./ICE
Direct Use of the Sun's Energy, Daniels F.
The Energy Primer, Portola Institute

Trainer Note

In preparation of this session, place a large tray outside at night with a shallow (2cm) layer of water and a thermometer in it. Record the temperature of the water in the evening, as late as possible, and in the morning before the sun shines on the tray. Share this information with the "Improved Cooling Devices" group in Step 2. Locate as much material as you can on the subjects of this session, to be used as resources.

PROCEDURES:

Step 1: 5 minutes
Post the steps of the session and review.

Step 2: 30 minutes
Divide the large group into four smaller groups: Traditional Cooling Methods, Improved Cooling Methods, Traditional Rainy Season Drying and Improved Rainy Season Drying. Have each group research and record as much information as it can, to be reported in the next step.

Trainer Note

Distribute the resources to the appropriate group. Offer the help of trainers where needed. Suggest that individuals who have interest or knowledge in one of the areas, join that group.

Step 3: 40 minutes
Have each group report their findings to the large group.

Trainer Note

Facilitate the reports. Discuss each topic fully. Ask for questions from the group. Answer those questions the small groups cannot answer.

Step 4: 10 minutes
Conclude the reports with general questions and answers.

Trainer Note

Point out that the cooling techniques use one or both of these:

1. blocking heat gain (such as shading) and/or
2. dumping heat (giving up heat to water, earth or air)

and that the "improved cooling" techniques are just extensions or adaptations of the "traditional techniques".

Point out the many examples of rainy season dryers in the "Catalog of Dryers and Stores" and that some stores double as rainy season dryers.

Step 5: 5 minutes
Conclude the session by reminding everyone of the design and construction up-coming sessions and that they can design and build a cooler or rainy season dryer if they choose (and if it is applicable to their local climate.)

SESSION #10 **DESIGN OF DRYERS AND STORES**

TOTAL TIME: 2-4 Hours

OBJECTIVES: By designing a dryer or storage device, participants will better understand the importance of good design in the construction process.

By drawing on information gathered in previous sessions (such as the community assessment, smoke test, model construction, natural cooling and rainy season drying), participants will understand the integrated nature of the training program.

By using the materials cost sheet, participants will be able to determine the cost of their design and be able to modify it to reduce the cost, if necessary.

By working in small groups, participants will be able to develop better communication and problem-solving skills.

MATERIALS: Notebooks and pens, pencils, construction materials (see Session 11), modeling materials (see Session 7), rulers, graph paper.
Handout 10A "Materials and Tools List"
Handout 5A "A Catalog of Dryers and Stores"

RESOURCES: Handout 7A "Solar Dryer Design Considerations"
Handout 8A "Food Storage Design Considerations"
Dryer and storage resource books from bibliography (as available)
Mechanical drawing books (as available)
Community assessment reports (from Session 3)

PROCEDURES:

Step 1: 5 minutes
Review objectives and note procedures.

Step 2: 10 minutes
Post and review the list of Handouts and books listed under "Resources".

Step 3: 2-4 hours
Form small construction teams (of 2-5 people), list "design criteria", decide on the best design that meets those design criteria, make a detailed drawing of the design, make a list of all tools and materials needed, determine the cost of the finished product and get the design approved.

Trainer Note

You may want to post and review the list of procedures listed in Step 3. Remind participants to design systems which use as many locally available materials as possible. Keep the cost low (decide on a ceiling cost depending on budget, materials available, etc.), point out which designs in which books are too "high tech", too expensive and which use inappropriate materials.

Remind the group that their construction team does not necessarily have to be the same team that designed and built the model. Suggest that the construction teams be made up of people from the same climate zone. Have teams who have a good idea of what they're going to design and build share that with the group. Suggest that each group determine their own "design criteria" such as buildable in 22 hours, needs only simple tools for construction, no milled lumer, locally available materials, etc. Suggest each group come up with at least 3 completely different designs and choose the best design from them.

Circulate among the groups if needed. Act as a resource person. Give helpful and constructive critcisms, where needed. Remind groups to list tools and materials needed, determine total costs. Have one person in each group clearly draw their design on a sheet of paper.

Remind the group that each design has to be checked and approved by a trainer before construction can begin. Point out that construction can begin as soon as a design is approved, but that construction will proceed smoothest if more time is spent in the designing phase. Remind people that construction is scheduled for every afternoon for the rest of the training (just about), with an optional construction session Saturday afternoon. Help the construction teams develop a form or flowchart on how to decide on a design, if necessary (generate many preliminary designs, list advantages and disadvantages of each, decide on one design, make a detailed drawing or model of it to identify any design errors, modify it or choose another design, build it, test it, modify it or reject it, re-build it, etc.).

SESSION #11 **CONSTRUCTION**

TOTAL TIME: 22 Hours

OBJECTIVES: By working in small, continuing groups, participants will develop tool, construction, group and problem-solving skills and learn how to work with local people, materials and tools.

MATERIALS: (See Trainer's Guide for a detailed shopping list of tools and materials.) Tools: Shovels, saws, hammers, pliers, tin snips, trowels, paint brushes, buckets, wood chisels, tape measures, files, bubble level.
Materials: Mudblocks, cement, sand, gravel, clay, chicken wire, plastic sheet, window screen, mosquito netting, wire, twine, rope, nails, paints, metal roofing, fiberglass roofing, milled lumber, large woven storage baskets, woven mats, bush poles, bamboo poles, reeds, calabashes, metal containers, tin cans

RESOURCES: Dryer and storage books and plans (as available, see bibliography)
Handout 5A "A Catalog of Dryers and Stores"
Handout 5B "Food Drying Considerations"
Handout 5C "Food Storage Considerations"

Trainer Note

This session requires substantial preparation time for gathering the tools and materials (listed in the Trainers Guide) in quantities sufficient to build one device per every three or four participants. This 22 hour session allows much time for individual trainer styles and is not meant to be offered in 22 continuous hours. In fact, it is helpful to work in 4 hour sessions, which will allow time outside of construction sessions to discuss the process and the device. It is suggested that the 4-hour construction sessions be scheduled in the afternoons. Construction naturally follows design. Those groups with satisfactory plans for their device should proceed with construction without waiting for the other groups.

Remind the participants to unload and reload their dryers (from Sessions 2 and 13) during their construction time in the second week.

PROCEDURES:

Step 1: 15 minutes
Introduce the construction session(s), discuss group dynamics, problem-solving, goal/people orientation, safety procedures, time limits, design review and improvements, materials used.

Trainer Note

Gather entire group and discuss "how's it going?" for about 5 minutes at the beginning of each construction session. Circulate between groups and point out unsafe tool use, but allow participants to make (and learn from) their own mistakes. Help people find tools and materials as needed. Remind people that while it would be nice if a device (or possibly two) was actually completed during this session, the decision-making and group skills are just as important in a community development aspect as are completed projects (since the time allotted for actual construction is admittedly short). Remind groups of the time so that they can clean up their tools and put things away at the end of the session(s).

Step 2: 22 hours
Construct solar dryer or improved storage device.

Step 3: 5 minutes
Check-in at the end and/or beginning of each day for group to share observations, questions, methods, difficulties, etc.

SESSION #12 **FACILITATION SKILLS**

TOTAL TIME: 2 Hours

OBJECTIVES: By designing and carrying out a training activity, the participants will become more comfortable with those skills necessary for effectvie community development work.

By developing a list of criteria for good facilitation skills, the participants will be able to evaluate their activity and the sessions given by trainers.

MATERIALS: Newsprint, markers, notebooks, pens.

RESOURCES:
Handout 12A "Guidelines for Process Observer"
Handout 7A "Effective Group Survey"
Handout 8B "Extension, Training and Dialog"

Trainer Note

This session requires flexibility on the part of the trainer: the session should be allowed to go in the direction felt necessary by the participants. The trainer should point out that the skills developed during this session will be very useful in future training programs given by the participants, in general interactions, in teaching/learning situations and in meetings.

PROCEDURES:

Step 1: 10 minutes
Post, review and clarify objectives and procedures for the session.

Trainer Note

Clarify the definition of facilitation (i.e.,: from the Latin word, "facil" meaning to make easy) and that, as extension workers, we all need effective skills for helping, guiding or facilitating a group or group process. A facilitator could be thought of as a communication guide or helper.

Step 2: 5 minutes
Identify the group resources.

Trainer Note

Ask who has been through a "hands-on" training program? Who has been involved with adult education programs? Who has used participative education techniques? What types? Was it successful? Why? How?

Step 3: 10 minutes
Identify written resources.

Trainer Note

Refer to Handout 8B "Extension, Training and Dialog", p. 5-7

Step 4: 10 minutes
Develop an activity to meet the objectives.

Trainer Note

It is important to clarify **one** goal or objective on which the group can focus. Post in front of the group, "To develop a list of facilitation skills that can be used in meetings in the village". Remind the group that the list of facilitation skills will be posted and used in the remainder of the training program. Point out that anything gained from this session will be helpful for all of us to evaluate the trainers and the presentations given later in the program. Therefore, the session cannot "fail": because some valuable information will come from the session.

Step 5: 10 minutes
Turn over the session to the group.

Trainer Note

Remind the participants that it is their responsibility to conduct the next hour of the session. Post this suggested sequence in front of the group:

1. Identify human and written resources (already done).
2. Redefine the activities objective (if necessary).
3. Decide on an activity to meet the objective from this list:
    a. brainstorm
    b. small groups
    c. large group discussion
    d. role play
    e. other
4. Carry out the activity (40-50 minutes).

Trainer Note (continued)

Ask for individuals to volunteer for the four roles:

1. Facilitator, to guide the group through the activity.
2. Recorder, to write down the list as it is developed.
3. Timekeeper, to remind the group of the time remaining.
4. Process Observer, to oserve the group and give feedback (hand one copy of Handout 12A to the person who volunteers for this role).

Step 6: 40-50 minutes
Carry out the activity.

Trainer Note

Turn the session over the the new facilitator, remind the timekeeper of the time limit and leave the next 40 or 50 minutes to the group.

Step 7: 25 minutes
Evaluate the activity.

Trainer Note

Refer participants to Handout 12A and have the process observer share her/his comments with the group. Ask the group if they have any other answers to the questions on the Handout.

Ask the group how they felt about conducting their own session. Was the process frustrating? Would they prefer a top-down approach? Was the process too slow?

Refer to Handout 8B "Extension, Training and Dialog" and the remarks "it is impossible to dialog with farmers because they know so little" and "dialog is too slow". If the group voices frustration, remind them of the parallels of this program and effective development work: the process is slow, is never easy, but it is always important to allow individuals and communities the opportunity to make their own decisions.

Step 8: 5 minutes
List generalizations of the session.

Trainer Note

Ask what, if anything, the group learned during this session, such as the importance of good facilitation skills, the importance of participation and dialog, the slowness, the frustration, specific ideas on how to (or how not to) facilitate, the list of facilitation skills (whether it is partial or complete).

Step 9: 5 minutes
Apply the information developed to the rest of the training.

Trainer Note

Ask for a volunteer to clarify or refine the list to be posted or distributed, and used throughout the training program, especially in Session 17 "Mid -Program Evaluation"; Session 27 "Program Evaluation" and Session 29 "Presentation of Devices".

SESSION #13 **UNLOAD DRYERS**

TOTAL TIME: 2 Hours

OBJECTIVES: By unloading their dryers and checking foods for dryness, using a variety of methods, participants will complete the lists of drying tips and tests for dryness by referring back to their previous notes.

By observing problems associated with some food and dryers, participants will be able to determine solutions to the problems which could be used in the design and construction of their own dryer (or storage device).

MATERIALS: Dried foods, unloading "trays" (pieces of cardboard, plastic or paper), hammers, fine dry salt, small, dry clean jars with lids, conditioning containers, cloth sheets, newsprint, markers, tape, notebooks and pens.

RESOURCES:

Handout 13A	"Tests for Dryness"
Handout 13B	"Percent Moistures for Grains and Legumes"
Handout 13C	"Summary of Temperature Factors"
Handout 13D	"Conditioning and Pastuerizing"
Handout 2A	"Tips for Drying"
Handout 2B	"Data Collection Sheet"

Trainer Note

Gather all of the materials (except the dried foods) and assemble it in the place where this session will be held. (This session can be held out by the dryers or in an outdoor classroom, but not necessarily in the standard classroom, although it should start there.)

This session sequence (unload the dryers, test for dryness, reload the dryers) should be repeated as many times as possible during the training program. Recommend to the participants that they repeat this sequence during their Construction Sessions, especially during the second week of the training. Remind the construction teams of the importance of this repetition to gain experience with different types of foods, different methods of preparation, different lengths of time in the dryers and under different climatic conditions, in a low-risk environment in which they can learn from their mistakes.

PROCEDURES:

Step 1: 5 minutes
Review objectives and note procedures.

Step 2: 10 minutes
Have everyone unload the dryers, placing the foods onto the unloading trays provided, noting which foods came from which dryer and then reconvene in the designated place.

Trainer Note

Refer everyone to the information they wrote on Handout 2B "Data Collection Sheet".

Step 3: 20 minutes
Have everyone examine the foods from the different dryers, test them for dryness, share new tests for dryness and write down their observations.

Trainer Note

Refer everyone to Handout 13A, "Test for Dryness", 13B, "Percent Moistures for Grains and Legums, 13C, "Summary of Temperature Factors, and 13D, "Conditioning and Pastuerizing". Distribute the jars and salt for the salt test, the hammers for the "blunt object test" and ask people to share any new and different "tests for dryness". Encourage people to taste the dried foods.

Step 4: 15 minutes
Make additions and corrections to the handouts.

Trainer Note

Post newprint labelled "Additions to 2A" and "Additions to 13A". Write down any corrections or additions as they are mentioned. Answer questions on any of the Handouts.

Step 5: 50 minutes
Reload dryers, begin conditioning and clean-up.

Trainer Note

Have everyone take this new information and either reload those foods not yet dry or load freshly prepared foods (following the "improved tips for drying"). Encourage people to begin pastuerizing or packaging dried foods.

SESSION #14 **ECONOMICS**

TOTAL TIME: 2 Hours

OBJECTIVES: By discussing the different levels of economic analysis that are possible, the participants will better understand the economic issues of food drying and storage.

By preparing and delivering an economic presentation, the participants will gain experience in economic analysis and speaking before a group.

MATERIALS: Flipchart and markers, notebooks and pens.

RESOURCES: Handout 14A "Sample Cost/Benefit Analysis of a Solar Dryer"
Handout 14B "Lifecycle Unit Cost Analysis of a Solar Dryer"
Handout 14C "Economic Comparison of Two Maize Stores"
Quantitative Procedures and Applications, Cost/Benefit Analysis and Project Design, USAID

PROCEDURES:

Step 1: 5 minutes
Review the objectives and outline the procedures.

Step 2: 15 minutes
List and discuss village-level economics and discuss the differences and similarities between village-level economics and city economics.

Trainer Note

City economics will be concerned with such things as material and labor investments, depreciation, transportation, overhead, return on investment, etc. Village economics generally is concerned only with "simple profit" and not concerned with labor cost but labor time.

Step 3: 15 minutes
Review the Session's handouts.

Trainer Note

Introduce the handouts as three different ways of analyzing the economics of dryers and/or stores: Handout 14A, "Sample Cost/Benefit Analysis of a Solar Dryer", helps to make the decision of "build or don't build", "invest or don't". Handout 14B, "Lifecycle Unit Cost Analysis of a Solar Dryer", points out how much the new device will cost per unit weight over its lifetime. Handout 14C, "Economic Comparison of Two Maize Stores", graphically describes the economic advantage of an improved store. Discuss each handout as needed and as time permits.

Step 4: 20 minutes
Form small groups to prepare a presentation on: (1) requesting funding (writing a funding proposal) for a dryer/storage program; (2) describing the economic advantages of improved dryers/stores to a group of PCVs; (3) describing dryer/storage economics to a civic leader; (4) explaining dryer/store economics to a wealthy farmer; and (5) explaining dryer/store ecnomics to a villager.

Trainer Note

Post the list of presentations and ask people to identify if they have interest or experience in them. It is not necessary to form a group for each item listed: some items may have two groups and some new group may form with a different focus. Offer assistance to each group as needed. Remind the groups of the time remaining.

Step 5: 40 minutes
Have the groups deliver their presentation. Discuss each presentation after it is given.

Trainer Note

Facilitate the presentations, ask for questions and comments and move from one presentation to the next, quickly. Process each presentation to see if it met its goal, if it was clearly presented and suggestions for improvements.

Step 6: 10 minutes
Conclude the session by reviewing the handouts and presentations, pointing out the various ways in which economics can be presented and the variety of topics (besides dryers and stores) for which economic analysis can be used.

SESSION #15 **STORAGE PESTS AND THEIR CONTROL**

TOTAL TIME: 2 Hours

OBJECTIVES: By sharing information about the damage, symptoms, prevention and control of storage pests and molds, the participants will develop skills for solving grain storage problems.

By identifying and utilizing group resources and available texts, the participants will have a better understanding of the information sources available to them to resolve local drying and storage problems.

MATERIALS: Notebooks, pens, chalkboard, newsprint, markers, tape, bookmarks, samples of moldy grain, insect infected grain, rodent damaged grain, etc..

RESOURCES: Handling and Storage of Food Grains in Tropical and Subtropical Areas
Postharvest Food Losses in Developing Countries
Small Farm Grain Storage
Programming and Training for Small Farm Grain Storage
Green Revolution: Grain Storage, Carl Lindblad, Rural Technology Bulletin March/August 1982, No. 12, USAID Africa Bureau/Regional Affairs
Country-specific pamphlets, texts, etc. on storage problems
Local people with knowledge of pest, mold and rodent damage of stored foods

Trainer Note

This session requires some preparation: it will be necessary to have on hand several copies of the books and articles listed under "Resources". To save time during the session, identify relevant sections of each text before the class and mark them with the bookmarks. Teams will be investigating the following: (1) Molds: Identification and control; (2) Insects: Identification; (3) Insects: Prevention and control; (4) Rodents: Identification; and (5) Rodents: Prevention and control. Prepare a sheet of newprint of each team with the headings: For Identification Teams: (a) types in country; (b) storage problems; (c) prevention and control; (d) damage; (e) symptoms; (f) life-cycle of pest. For Prevention and Control Teams: (a) non-chemical methods; (b) chemical methods.

PROCEDURES:

Step 1: 5 minutes
Review objectives and post session procedures.

Step 2: 5 minutes
Identify and discuss resources.

Trainer Note

Ask the group to identify people present who have knowledge or background in recognizing and dealing with local storage problems (i.e., counterparts, local villagers, Volunteers with agricultural background or degree, etc.) Ask the group to be conscious of equal distribution of these human resources for the small group activity. Briefly discuss the written resources available to each group (as listed in the Session Trainer Note).

Step 3: 40 minutes
Form small groups of 3-4 participants to research storage problems, prevention and control; and summarize their findings on newsprint.

Trainer Note

Provide reference texts, prepared newprint (see Session Trainer Note) and marker to each group. Suggest that each group have a recorder (to list information on newprint) and a reporter (to present findings to the large group). Remind the groups when they have 10 and 5 minutes remaining in this step.

Step 4: 60 minutes
Return to the large group and have each team present their findings. Allow each group 5-8 minutes for their presentation and time for questions from the large group.

Step 5: 5 minutes
Review the session format and how each group made use of both written and human resources.

Trainer Note

Ask if a dialog was established between people with knowledge of local storage problems and other participants. Ask how the group would like to make use of the information gathered in this session (ask for volunteers to compile the information into a handout or poster that can be distributed later).

For follow-up, have the participants visit local farmer(s) to find out what perceived and real storage problems are and do a method demonstration on prevention and control methods. (Refer to Sessions 18, 19, 20, 21, 23 and 24.)

SESSION #16 **OTHER TECHNOLOGIES**

TOTAL TIME: 2 Hours

OBJECTIVES: By discussing technologies other than dryers, the participants will better understand the similarities and differences in those other technologies.

By providing the participants with needed or wanted information, the trainer can enhance the quality of the training program.

By meeting the needs of the participants, the trainer can demonstrate the parallels between the training program and effective community development work.

By taking advantage of information or knowledge held by participants, the trainer can demonstrate the parallels between the training program and community development work while the participants can practice their facilitation skills.

MATERIALS: Flipchart and markers, examples of devices (if possible)

RESOURCES: Direct Use of the Sun's Energy F. Daniels
The Energy Primer
The Chinese Biogas Handbook
Appropriate Technology Sourcebook
List of "other technologies" from Session 1.

Trainer Note

This session will require some preparation. Before training begins, research the following: Photovoltaics (solar electricity), solar hot water, solar distillation of water, solar house design, solar ovens and solar cookers. Also of interest may be sand filters, grey-water disposal, improved privies, rain catchment, bio-gas, pedal power, earthen stoves, hydrams, wind (pumping and electricity), ferrocement and others. If you are not comfortable presenting a short (10-20 minutes) talk on each of these, ask if one of the participants can give a 20 minute talk or an optional evening session on them. Some expectations will not be able to be met.

PROCEDURES:

Step 1: 5 minutes
Develop objectives and procedures as a group.

Trainer Note

Have the group list the "other technologies" in which they are interested and the method of presentation they would prefer.

Determine order of presenting during the session and the time allotted for each.

Step 2: 1 hour 40 minutes
Give a brief presentation on each technology, using the flipchart and markers. Answer questions as they develop.

Step 3: 10 minutes
Find out if another session like this one needs to be scheduled and who can lead it. Note parallels between this session (how it was created, the lists, the presentation) and community development work. Check to see if exptectations and objectives were met.

SESSION #17 **MID-PROGRAM EVALUATION**

TOTAL TIME: 2 Hours

OBJECTIVES: By evaluating the first week of training, the participants will understand the importance of their feedback to the improvement of the program.

By rescheduling the second week of training (if necessary) to meet the needs of the participants while still fulfilling the needs of the contract, the entire group will show flexibility and cooperation, which is useful in effective community work.

By giving and receiving feedback, the group will re-establish a feeling of solidarity and program ownership.

MATERIALS: Flipchart and markers, tape or thumbtacks, blank one-week program schedule on flipchart paper.

RESOURCES:
Handout 17A "Mid-Program Evaluation"
Handout 17B "Blank One-Week Program Schedule"
Handout 17C "Coat of Arms"

Trainer Note

Instead of the evaluation process outlined in this session, the trainer may want to use the "Coat of Arms" (Handout 17C), by having everyone fill in their Coat of Arms by drawing a picture in each area, which represents: (1) What has been our major failure as a group? (2) What has been our major accomplishment as a group? (3) How do our interations here reflect interactions we have in our own regions? (4) What is our major unresolved conflict or problem as a group? (5) What can we do to resolve this problem of conflict? (6) What can we do to improve our interaction skills in general? Then have everyone explain their pictures to the group (which takes a considerable amount of time). The "Coat of Arms" is recommended only for those groups which are non-literate and/or very small.

PROCEDURES:

Step 1: 5 minutes
Review objectives and list procedures.

Step 2: 20 minutes
Have the participants evaluate the training program to date by completing Handout 17A "Mid-Cycle Evaluation Form" and by answering the following questions in their notebooks: "What has gone well?" and "What hasn't gone well that you would like to see changed?"

Step 3: 15 minutes
List and discuss "what went well".

Trainer Note

The trainer should feel free to add to the lists in Step 3 and 4.

Step 4: 30 minutes
List and discuss "What hasn't gone well that you would like to see changed?"

Trainer Note

The trainers should discuss and comment on each item of criticism listed in this step.

Step 5: 30 minutes
Post a blank schedule of the second week of training and ask if any changes need to be made in the proposed schedule.

Trainer Note

Negotiate changes so that contract needs are met and participants needs are met (assuming the participants' needs can be met).

Step 6: 15 minutes
Conclude the session.

Trainer Note

Discuss any other program-related feedback the participants or trainers might have. Keep discussion **PROGRAM** related.

Trainer Note (continued)

Discuss the "community development" aspect of this evaluation, how flexibility is important in a development process, how the participants are a community, how their needs are being met, the need for commmunication and cooperation, the need for periodical evaluations, etc.

Wrap up the evaluation session and the first week of training on a positive note by having someone from the group describe what he or she has learned over the past week and what he or she is looking forward to in the next week.

Remind everyone of the optional construction session following.

SESSION #18 **INTRODUCTION TO NON-FORMAL EDUCATION**

TOTAL TIME: 2 Hours

OBJECTIVES: By observing and processing a short role-play, the participants will better understand the value of Non-Formal Education (NFE) in effective technology transfer.

By observing a picture story and developing a list of processing (reflecting, generalizing and applying) questions that could be addressed to rural people, the participants will understand the importance of the processing of NFE activities.

By choosing a problem and an NFE technique to explain that problem to a rural audience, the participants will take the first step in practicing an NFE technique and processing.

MATERIALS: Newsprint and markers, notebooks and pens

RESOURCES: Handout 18A "A Partial List of NFE Activities"
Handout 18B "Some Guidelines for Motivating and Teaching Groups"
Handout 18C "Role Play Guidelines for Extension Workers"
Handout 18D "People's Theater"
Picture story showing a real problem that is presently facing the country and relates to drying and/or storage of food
Adult Learning Loop (From Session 8)

Trainer Note

This session requires the development of a role play that depicts the improper or inappropriate introduction of a technology (i.e., how NOT to introduce a lorena stove, the introduction of a waist-high, Guatemalan stove to an African culture used to cooking on the ground; the introduction of tractors without teaching people how to change the oil; the introduction of improved plants needing high-nitrogen fertilizer without introducing the fertilizer, etc. Also, prepare a country-specific picture story depicting a drying or storage problem.

PROCEDURES:

Step 1: 5 minutes
Present the role-play showing inappropriate technology transfer.

Step 2: 15 minutes
Process the role-play.

Trainer Note

Some sample questions for processing the role-play:

Processing:	What happened? What did you see take place? What was the problem? What was the point of the role-play?
Generalizing:	What was the general meaning of the role-play? What should be taken into account when introducing a new technology? What can we learn from this?
Applying:	How can this information be used in introducing a new technology? How does this role-play apply to effective community work?

Step 3: 10 minutes
Process how NFE techniques differ from traditional teaching methods.

Trainer Note

Ask, "How did this presentation differ from traditional teaching methods? What is the 'student-teacher' relationship? How did the participants gain information? Who supplies the answers? Which answers were deemed 'right'? Who decided? What was the role of the facilitator? Was the learning active or passive? How could you tell? How were the participants motivated?"

Step 4: 10 minutes
Have the group generate a list of "Non-Formal Presentation Guidelines" based on the previous step.

Trainer Note

The list should include: The presentation is relevant to the participants' needs, day-to-day priorities and experiences; the presentation is geared so that learning is shared between facilitator and participants; the presentation provides situations that require the active participation of the learners; the presentation included questions that stimulate active discussion among participants; the presentation and its processing motivates participants to adopt new attitudes or practices.

Step 5: 10 minutes
Present the picture story depicting a real drying or storage-related problem presently in the country (i.e., someone becoming sick or dying from moldy grain ingestion, problems associated with rainy season drying and storage problems, rates, the application of DDT to food grain, etc.)

Trainer Note

Remind the participants that they should watch the picture story thinking of what questions **they** will ask to process the presentation (as if it were given to rural people). Keep the picture story short and lively. Give the "captions" verbally instead of written on the pictures, to avoid confusion, and to give color and accent to the words.

Step 6: 15 minutes
Write the group's process questions on newsprint.

Trainer Note

Refer to the adult learning loop and ask, "What are some reflective questions? What would you ask to generlize the story? and, What would you ask to get people to apply this information in the future"? Point out that the processing of any NFE activity is as important as the activity itself.

Step 7: 30 minutes
Refer to Handout 18A, "A Partial List of NFE Activities",18B, "Some Guidelines for Motivating and Teaching Groups", 18C, "Role Play Guidelines for Extension Workers" and 18D, "People's Theater". Discuss and clarify each item on Handout 18A.

Trainer Note

Ask members of the group to define those items that are unclear or need definition. If they cannot, then provide the definition and an example, while referring participants to the reference materials, Handouts 18B, 18C and 18D. Remind everyone that method demonstrations will be the focus of Sessions 20 and 21.

Step 8: 10 minutes
Generate a list of "relevant problems" from which small groups can choose to prepare, present and process an NFE activity with the group during the following session (Number 19).

Trainer Note

Ask for people to volunteer for one of the problems listed until everyone has signed up. Encourage teams to use a technique that is new to them. Remind everyone of Sessions 20 and 21 during which they prepare, present and process method demonstrations.

Step 9: 10 minutes
Conclude the session by referring back to the objectives, then allow time for each group to meet to begin deciding on their NFE technique.

SESSION #19 **NON-FORMAL EDUCATION PRESENTATIONS**

TOTAL TIME: 2 Hours

OBJECTIVES: By preparing an NFE activity, the participants will gain experience in planning other NFE activities.

By preparing the process questions for their activity, the participants will understand the importance of processing; and gain experience in planning the processing of the activity.

By presenting and processing an NFE activity, the participants will gain experience before a group.

MATERIALS: As needed by each team.

RESOURCES: Handout 18A "A Partial List of NFE Activities"
Handout 18B "Some Guidelines for Motivating and Teaching Groups"
Handout 18C "Role-Play Guidelines for Development Workers"
Handout 18D "People's Theater"
Helping Health Workers Learn
Perspectives on Non-Formal Education
From the Field

PROCEDURES:

Step 1: 5 minutes
Review the objectives and sequence of the session.

Step 2: 30 minutes
Have the teams formed in Session 18 develop their NFE activity and process questions.

Trainer Note

Remind everyone of the resources (human and written) available to them and that processing questions are at least as important as the activity itself and should follow the adult learning loop of reflection, generalizing and applying. Check with each group occassionally (if possible) to offer help and suggestions. Remind each group when the step has 10 and 5 minutes remaining.

Step 3: 5 minutes
Gather the large group. Check to see that each group has developed an activity and processing questions. Remind them of the time limitations (15 minutes for each group, including processing, depending on the number of groups). Ask for the first group to give their presentation.

Step 4: 1 hour, 15 minutes
Each group presents and processes their activity.

Trainer Note

Process each activity, but not NFE techniques in general, because this will be done in the next step.

Step 5: 10 minutes
Conclude the session by reflecting on the activities and their applicability in rural extension work.

Trainer Note

Ask what went well during the session and what could have gone better. Ask how people felt giving their presentations. Ask how they felt about processing. Ask how they felt participating as an audience. Ask how NFE activities can be used in the rest of the workshop and in future extension work.

SESSION #20 **INTRODUCTION TO METHOD DEMONSTRATIONS**

TOTAL TIME: 2 Hours

OBJECTIVES: By observing and processing a method demonstration, the participants will better understand this extension technique and its application at the village level.

By discussing the planning and preparation of a method demonstration, the participants will be better able to organize themselve to give effective presentations in the future.

By participating in a method demonstration, the participants will gain technical skills relevant to grain storage.

MATERIALS: Sufficient materials for 6-7 people to participate in a method demonstration, notebooks, pens, newsprint, marking pens and tape.

RESOURCES: Handout 20A "Evaluation of Method Demonstrations"
Handout 20B "Planning a Method Demonstration"
Handout 20C "Method Demonstration Guidelines"

Trainer Note

This session requires the planning and materials acquisition for a method demonstration. The trainer or a participant who is experienced with method demonstrations can present it. Be sure the presentation is well-prepared and -presented because this is the model for setting standards. Some suggested topics are: how to make a rat guard, how to put on a rat guard, how to treat beans with oil to keep out weevils, how to apply malathion or pyrethrum to stored grain or how to test for dryness. (See a more complete list in the Trainer Note for Step 7.)

PROCEDURES:

Step 1: 5 minutes
Review objectives and procedures.

Step 2: 20 minutes
Present the method demonstration.

Trainer Note

Have the participants take note on the presentation process and components. Ask for 6-7 people in the group to participate and ask the remainder to observe. Keep the demonstration brief. Follow the outline listed here (and detailed in Handout 20B, "Planning a Method Demonstration" and 20C "Method Demonstration Guidelines".

I. Introduction
   A. Handshake and small talk to establish rapport with participants.
   B. Tell who you are (name, organization, where and how to contact you).
   C. State the topic of the demonstration.
   D. State 3 reasons why it is important to adapt this practice.

II. List and show materials and tools needed to do the demonstration.

III. Procedures:
   A. Follow a logical step-by-step procedure.
   B. Do the demonstration yourself, first, then encourage all participants to try it.
   C. Use visual aids (models, real objects, posters).
   D. Provide repetition at key points.
   E. Avoid complicated language and technical terms.
   F. Maintain control of the participants.
   G. Solicit questions from the participants to clarify.
   H. Direct questions to the participants to check their comprehension.

IV. Summary
   A. Restate quickly why the new practice is important.
   B. Review quickly the main steps of the demonstration or ask the participants to do so.

V. Closing and good-bye.
   A. Thank the participants for coming and taking part.
   B. Offer individual follow-up help.
   C. State where and when you can be reached.
   D. Farewell handshake.

Step 3: 20 minutes
Have the group define a method demonstration and outline its steps.

Trainer Note

Write the group's definition of a method demonstration and their list of the steps on newsprint. Use the outline in Step 2 as a guide.

Step 4: 10 minutes
Decide on criteria for evaluating method demonstrations.

Trainer Note

If time is short, have the group review Handout 20A, otherwise, have the group develop their own list of evaluation criteria and post on newsprint.

Step 5: 20 minutes
Have the group list the procedures of preparing and organizing a method demonstration.

Trainer Note

Have the group read and discuss Handout 20B and 20C. Ask the following questions: "Where and when should a method demonstration take place? How long should one be? How many people should be involved? How can visual aids, questions and answers be included? How can you avoid "top-down" approach"?

Step 6: 10 minutes
Discuss the follow-up of method demonstration.

Trainer Note

Be sure to emphasize the importance of individual follow-up, getting to know interested farmers and record keeping, including: (1) who has adopted the new practice; (2) who has not and why; (3) suggested improvements to suit local needs and (4) general interest of the farmers involved.

Step 7: 10 minutes
Brainstorm a list of method demonstration topics that are relevant to the country and the participants.

Trainer Note

Possible demonstration topics are: how to prepare a storage bin for receiving newly harvested grain, how to dust malathion to ear corn in a crib, how to make a rat guard out of a 20 litre can or sheet metal, how to dust shelled grain with malathion, Actellic, or pyrethrum, how to effectively use an anti-coagulant rat poison, how to admix ash, sand or diatomaeous earth with grain for storage, how to disinfest last year's storage bags for re-use, how to use Phostoxin fumigant tablets with stored grain in fertilizer sacks, how to prevent weevils in beans using vegetable oils, how to provide airtight storage for small quantities of seed, how to periodically check a grain store for pest damage, etc.

Step 8: 40 minutes
Have the group form teams and prepare a method demonstration on one of the topics listed to be presented during the next session.

Trainer Note

Encourage teams to give a method demonstration on a topic in which they either have an interest or experience. Refer everyone to the session's handouts as resources.

Remind the teams to keep the demonstrations short (10-15 minutes each) and simple, using only those materials that are on hand. Suggest that the demonstration focus on the devices they are building (if a maize store needs rat guards, for example, they could have people make them, then install them during this method demonstration).

Keep the number of teams to 5 or 6, so that each team will have enough time to give a 10-15 minute demonstration. Answer questions for 5 minutes and receive an evaluation for 5 minutes.

Step 9: 5 minutes
Conclude the session by refering back to the objectives to see if they have been met and refering ahead to the next session in which everyone will be able to participate in several method demonstrations.

SESSION #21 **PRACTICING METHOD DEMONSTRATIONS**

TOTAL TIME: 2 Hours, 30 minutes

OBJECTIVES: By giving and participating in method demonstrations, the participants will develop extension skills designed to share technical information.

By practicing chemical and non-chemical pest control methods, the participants will gain experience in safe and effective pest control methods.

MATERIALS: Sufficient materials for groups of 6-7 participants to carry out their method demonstrations (see Trainer Note, Step 7, Session 20 for a detailed list of possible demonstrations). Such as sheet metal, tin snips, Malathion powder, Phostoxin tablets, Actellic, anti-coagulant rat poison, rat traps, ash, sand diatomaceous earth, vegetable oil, salt, assorted grains, grain sacks, legumes, conditioning containers, etc.

RESOURCES: Handout 21A "Use of Vegetalbe Oils to Protect Stored Beans from Weevils"
Handout 20A "Evaluation of Method Demonstrations"
Handout 20B "Planning a Method Demonstration"
Handout 20C "Method Demonstration Guidelines"
Handout (from Session 15) "Storage Pests and Their Control"

Trainer Note

This session is a follow-up of Session 20, "Method Demonstration", in which teams have prepared a method demonstration on a topic of their own choosing.

PROCEDURES:

Step 1: 5 minutes
Review the objectives and note the procedures. Check to see if each team has prepared their method demonstration. Ask for the first group to present their demonstration.

Trainer Note

For each method demonstration have the presenting team address themselves to only 6 or 7 of the participants. The rest of the participants should act as observers, taking notes and filling out Handout 20A "Evaluation of a Method Demonstration". Allow each team 10-15 minutes for their entire demonstration, 5 minutes for questions and answers and 5 minutes for evaluation. Try to keep the group moving from one demonstration to the next about every 20 minutes, which will allow for 5-6 method demonstrations during this session. Suggest that the team whose demonstration is next prepare their demonstration while the one previous to theirs is being presented.

Step 2: 1 hour, 45 minutes
Have the groups give their demonstrations, answer questions and get evaluated.

Step 3: 10 minutes
Reconvene the large group and evaluate the session as a whole.

Trainer Note

Encourage participants to give constructive criticisms. Discuss which demonstrations could be presented at the village level, which could not and why. Remind the participants that they can do a method demonstration in a nearby village (if logistics permit) during the next several days (Sessions 23, 24, 26 or 29). Ask the group what kind of information they still need on pest control. Use this information to prepare for Session 24. Ask for volunteers to (1) help in the preparation for Session 24, (2) prepare for Session 24, (3) coordinate Session 24 (if it involves a field trip or a talk by a representative from a nearby chemical supply or farm supply store).

Thank the teams for their presentations.

Step 4: 10 minutes
Clean up the demonstration tools and materials.

SESSION #22 **LOCAL DEVELOPMENT PROJECTS**

TOTAL TIME: 2 Hours

OBJECTIVES: By allowing individual participants to share their appropriate technology or community development successes and failures with the group, everyone will be better able to critique proposed projects for appropriateness.

By allowing time in the schedule for interested people to share their work with others, the participants will see the value of others' experience.

MATERIALS: Slide projector and screen, (if slides of local projects are available).
Flipchart and markers, photographs or posters of local projects.

RESOURCES: Participants (Volunteers or local people) involved in community development and/or technical projects.

Trainer Note

This session, as it is written, allows time for two presentations plus questions, answers and feedback for each presentation. If there is more interest shown during Session 1, it is possible to shorten each presentation to allow more projects to be presented. Check with the group before starting. Keep to the time allowed for the presentations' questions-and-answer and feedback periods.

PROCEDURES:

Step 1: 5 minutes
Review the objectives and list procedures.

Step 2: 10 minutes
Introduce participants (PCV's or others) who will be giving presentations of development (technical or community) projects in which they have been involved.

Step 3: 20 minutes
First presentation.

Step 4: 5 minutes
Questions and answers.

Step 5:	10 minutes Feedback/suggestions.
Step 6:	20 minutes Second presentation.
Step 7:	5 minutes Questions and answers.
Step 8:	10 minutes Feedback/suggestions.
Step 9:	15 minutes List and discuss the general guidelines for appropriate technology projects. Draw parallels between technical and community development projects.

Trainer Note

This list may already have been developed by the participants. If so, review the list and add to it. Ask how technical projects can be used as community development issues or projects. Discuss learning from mistakes and/or experience being a teacher.

SESSION #23 **INDEPENDENT STUDY**

TOTAL TIME: 2 Hours

OBJECTIVES: By allowing scheduled time during the workshop when the participants can pursue information in fields outside the scope of the workshop, the participants will be able to meet some of their own needs.

By scheduling an independent study, allowing the participants to continue work on their devices or pursue library research, as needed, the participants will better understand the parallels between this program and development work.

MATERIALS: Notebooks and pens

RESOURCES: AT Sourcebook Volumes 1 and 2
Technical books
papers and reports (as available)

Trainer Note

This session allows time for scheduling a session in which only a small percentage of the participants are interested, one of the optional sessions, or a session expected by the participants but not scheduled or offered by the trainers. Be flexible and try to meet the expectations of the participants.

PROCEDURES:

Step 1: 10 minutes
Introduce the session referring to day one expectations; point out seriousness of independent study; set guidelines with the group for sharing information gained during this session.

Trainer Note

As a group, decide how individuals and small groups will share the information gained during this independent study period. Schedule time at the end of the session or at a later time, if possible. Allow the group to set the guidelines for the session. Ask if it is okay for people to work on their projects. Refer participants to Session 1 (day 1), when they listed free time as one of their expectations for the workshop. Refer to lists developed at that time (if available).

Step 2: 1 hour, 50 minutes
Independent study.

SESSION #24 **CHEMICAL AND NON-CHEMICAL PEST CONTROL**

TOTAL TIME: 2 Hours

OBJECTIVES: By taking part in an activity related to pest control, the participants will meet more of their expectations on the subject of pest control.

MATERIALS: As needed by the coordinator of the session.

RESOURCES: As needed by the coordinator of the session.

Trainer Note

This session could take a number of forms, as deemed necessary by the participants. At the end of Session 21, "Practicing Method Demonstrations" ask the participants what extra information they need in the area of pest control. Suggestions include:

1. On-Site Method Demonstrations (i.e., a continuation of Session 21).
2. Method Demonstrations given in a nearby community (if logistics permit).
3. A talk or demonstration by a representative from a local farm supply or chemical supply store.
4. A panel discussion or debate on chemical vs. non-chemical pest control methods.
5. Demonstrations given by local people on the subject of local pest control methods.
6. An activity suggested by the group.

Ask for a volunteer to assist in the preparation of the session or to actually coordinate the session. Work with this volunteer to see that the session will proceed smoothly.

SESSION #25 **ACTION PLAN**

TOTAL TIME: 2 Hours

OBJECTIVES: By developing a plan for the future (or action plan), the participants will process and generalize the experiences of the training program and apply their knowledge to their work back home.

By completing one cycle of the "learning loop" at this time during the training, the participants will be able to visualize the importance of the loop and its applicability to development work.

By creating a coherent action plan, the participant will be able to show the trainer how applicable and effective the training has been.

MATERIALS: Notebooks and pens

PROCEDURES:

Step 1: 5 minutes
Review objectives and procedures.

Trainer Note

Ask if anyone would like to share her/his action plan and if so, where, when and how?

Step 2: 10 minutes
Develop a list of "Action Plan Questions" that the participants should answer.

Trainer Note

The point of these questions is to get the participants to look ahead 3 months, 6 months and a year and envision what they are going to do with their dryer and storage information and how they are going to do it. The "Action Plan Questions" should include, but not be limited to:

- How will you involve your community in assessment, design, construction, evaluation of designs, follow-up and extension work?

Trainer Note (continued)

- Who will help you with the design and construction of your dryers and stores? Where will it be done? How much will it cost?
- How will you extend your information to other communities? To other counterparts? To other Peace Corps Volunteers?
- How will you guarantee that you will not take this new information away from your community when you leave?
- What do you expect to have accomplished in 3 months? Six months? A year?

Step 3: Up to 1 hour, 45 minutes
Have individuals or small, regional groups develop their action plan and turn it in to the trainers.

Trainer Note

Explain that the action plan is feedback for the trainer, showing the applicability and effectiveness of the training program. When the plans are turned in, people can begin working on their presentations. The trainer will read and return the plans during the presentation preparation session.

SESSION #26 **ASSESSMENT AND MODIFICATION OF DRYERS AND STORES**

TOTAL TIME: 4 Hours

OBJECTIVES: By developing and carrying out tests for their dryers and storage devices, the participants will better understand the on-going nature of appropriate technology projects.

By making improvements on their devices, the participants will be able to view their devices as projects that are never finished, but keep getting improved.

MATERIALS: Same as construction session.

RESOURCES: Handout 26A "Evaluation Checklist for Dryers and Stores"

PROCEDURES:

Step 1: 5 minutes
Review the objectives and list procedures. Refer to Handout 26A.

Trainer Note

This session can be seen as a continuation of the construction session in that testing and refinement (or assessment and modification) of any project will make that project a better one. If the groups are amenable to it, they can trade projects for this session.

Step 2: 3 hours, 30 minutes
Form work groups, develop testing, evaluation and assessment procedures, carry them out and modify dryers and storage devices to improve them, (make them less expensive, more weather-proof, add rainy-season heater, etc.),

Step 3: 15 minutes
Clean up.

SESSION #27 **PROGRAM EVALUATION**

TOTAL TIME: 1 Hour

OBJECTIVES: By giving feedback to the trainers, the participants will feel part of the training redesign process and recognize the role of evaluation in the development process.

By receiving feedback on the training program, the participants will better understand the participatory nature of the training program and how it relates to a development situation.

MATERIALS: Flipchart and markers, notebooks, pens and tape.

RESOURCES: Handout 27A "Program Evaluation"
Handout 27B "Appropriate Technology Information and Resource List"
Handout 27C "Descriptive Bibliography of Recommended Texts"
Handout 27D "Solar Drying and Improved Food Storage Bibliography"

PROCEDURES:

Step 1: 5 minutes
Review the objectives and outline the procedures. Refer to Handout 27A, "Program Evaluation", 27B, "Appropriate Technology Information and Resource List", 27C , "Descriptive Bibliography of Recommended Texts" and 27D, "Solar Drying and Impproved Food Storage Bibliography".

Step 2: 20 minutes
Have each participant fill out the program evaluation form.

Trainer Note

Encourage everyone to answer all of the questions. Point out that their responses will be used to improve training ability and in the final report of the training program. Ask for serious responses. Answer questions, as necessary.

Step 3: 5 minutes
List and discuss "What went well?"

Trainer Note

Write the list on newsprint at the front of the room. There is no need to repeat items but by marking repeated comments, a general sense of major and minor concerns will develop.

Step 4: 5 minutes
List and discuss "improvements".

Trainer Note

Write the list on newsprint. Ask for the improvements to be as specific as possible, to be of greater use in the rewriting of the manual and improvement of individual sessions or steps.

Step 5: 10 minutes
Ask if there are any other program-related questions that need to be answered. Refer to Handouts 27B and 27C as resource lists that can be consulted in the future, as needed.

Trainer Note

Allow everyone the opportunity to participate in the discussion, but do not allow the discussion to go beyond its comfortable limits. Try to end the session and the program on a positive basis.

Step 6: 5 minutes
Introduce Session 28. (See Trainer Note, Step 1, Session 28 before ending this session.)

SESSION #28 **PREPARATION OF PRESENTATIONS**

TOTAL TIME: 3 Hours

OBJECTIVES: By preparing a non-formal presentation of their dryer or storage device, the participants will apply the information gained during the training program, further develop their group skills and demonstrate creativity.

MATERIALS: Flipchart and markers, and materials as needed by contstruction teams.

RESOURCES: Same as Session 18

PROCEDURES:

Step 1: 5 minutes
Review outline and note procedures.

Trainer Note

This step can be done informally with individual construction teams or as the last step in Session 27, while the group is still together. This time should not be spent on finishing the device itself, unless the construction group can easily divide the labor. Refer the participants to previous, related Sessions (8,12,14,18,19,20,21 and 24). Encourage everyone to use non-formal education activities such as role-play and skits. (Refer to Handout 18A "A Partial List of NFE Activities.") Encourage creativity using available materials as stage, costumes, etc. Remind group of the time allowed for presentations. Suggest they practice the presentation at least once.

Step 2: 2 hours, 30 minutes
Form construction groups and develop a presentation of the dryer or storage device.

Step 3: 15 minutes
Clean up.

SESSION #29 **PRESENTATIONS OF DEVICES**

TOTAL TIME: 3 Hours

OBJECTIVES: By presenting their devices using non-formal education techniques answering questions and receiving feedback, the participants will gain experience in and understanding of the techniques of transferring technical information in a non-technical form.

By watching and giving feedback on the presentations, participants will better understand the design and construction of all of the devices built during the program and gain information about devices in which they did not personally participate.

MATERIALS: Same as Session 28

RESOURCES: Same as Session 28

PROCEDURES:

Step 1: 5 minutes
Welcome everyone to the presentations, review the objectives and outline the procedures. Ask for the first presentation to be given.

Trainer Note

Ask each group to introduce their presentation to the "audience" (and whether they are to play a role such as village members, school children, other PCV's, etc.).

Step 2: 3 hours
Visit each device and have each construction team give their presentation.

Trainer Note

Facilitate each presentation and discussion (questions and answers, feedback on the presentation, etc.). Keep the presentations moving.

Step 3: 5 minutes
After the last presentation, have everyone meet briefly in the classroom for the wrap-up.

SESSION #30 **WRAP-UP**

TOTAL TIME: 1 Hour

OBJECTIVES: By sharing final announcements, accepting Certificates of Completion and cleaning up the work site, the participants will feel a closure to the training program.

MATERIALS: Clean-up materials, as needed by participants.

RESOURCES: "Certificate of Completion" (see Trainer's Guide).

PROCEDURES:

Step 1: 15 minutes
Share final announcements.

Trainer Note

Ask for all library books to be returned, remind the participants of the final day(s) meal schedule and departure times, ask for any final questions, comments, observations, etc.

Step 2: 15 minutes
Distribute a "Certificate of Completion" to each participant.

Trainer Note

This is an important step, especially for the counterparts involved in the program. It is a good form of closure for the training. Thank everyone and remind them of the next step (clean-up).

Step 3: 30 minutes
Clean-up.

Trainer Note

This last clean-up should be a major cleaning of the construction site and tools. Work with the site coordinator or logistics person to assure a satisfactory job. Check that all tools are cleaned and stored in their proper place, leftover materials are properly sorted and the devices are either taken by the participants, placed in storage, put on permanent display or dismantled.

SESSION #A-1 **TECHNICAL SOLAR DRYER DESIGN INFORMATION**

TOTAL TIME: 2 Hours

OBJECTIVES: By reviewing and discussing technical design considerations for solar dryers, the participants who need this information will have their expectations met.

By comparing and contrasting these technical considerations with the considerations in Session 5, the participants will understand the need for varied levels of technical information in a dryer storage program and development work.

MATERIALS: Thermometers, gauze, rubber bands, string, newsprint, felt pens.

RESOURCES: Handout A-1 "Technical Solar Dryer Information"
ISES, Sunworld 1980, Vol. I, No. 6, pp. 180-181
Low Temperature and Solar Grain Drying Handbook, University of Iowa, Ames, Iowa, pp. 5-10, 16-22
Handling and Storage of Food Grains
Proceedings of the Solar Drying Workshop
Survey of Solar Agricultural Dryers
Handout 2A "Tips on Drying"
Handout 5A "A Catalog of Solar Dryers and Storage Devices"
Handout 13B "Percent Moistures for Grains and Legumes"
Handout 13C "Summary of Temperature Factors"

Trainer Note

This session is not in the general workshop schedule because the information found in the handout is usually too technical for most people. However, in the event that more technical information is needed or wanted by a number of the participants, this session could be included in the schedule. Even if it is not scheduled, Handout A-1, "Technical Solar Dryer Information", should be referred to those participants who need more technical information and the contents discussed with a trainer, using the following procedures.

PROCEDURES:

Step 1: 5 minutes
Review the objectives and outline the procedures.

Step 2: 60 minutes
Refer to Handout A-1. Review and discuss.

Trainer Note

Post and review the following key variables in solar dryer design (see page 1, Handout A-1):

1. Type of crop to be dryed. Grains, legumes, fruits, vegetables and fish all have different drying characteristics and precautions.

2. Weight of crop. A dryer can be designed to dry one kilogram of fish or 400 kilgrams of fresh fruit.

3. Original percent moisture. (See Handouts: 2A "Tips for Drying"; 5A "A Catalog of Solar Dryers and Storage Devices"; and, 13B "Percent Moistures for Grains and Legumes). The food's original moisture content (percent moisture) has a big effect on the design of the dryer.

4. Final percent moisture desired for satisfactory storage or sale. Different crops need to be dried down to different percent moistures for different purposes. Refer to Handout 13B "Percent Moistures for Grains and Legumes".

5. Weight of water to be removed. Can be calculated from numbers 2,3, and 4, above.

6. Heat and moisture capacity of air. Warm or cold, dry or humid. Air changes during the day, during the year and from place to place.

7. Volume and weight of air needed to remove given weight of water. Information from numbers 5 and 6 above is used here.

8. Solar gain. The strength of sunshine varies from place to place and month to month.

9. Vent area. (Refer to Session 6.) Larger Vents allow more air to pass through the dryer, this cooling it off. Smaller vents allow the dryer to heat up, but cannot pass enough air to dry the crop. Vent sizing is critical.

10. Chimney height. (Refer to Session 6.) Higher chimneys give higher air flows.

11. Change in temperature. (Refer to Handout 13C "Summary of Temperature Factors".) There are optimum and maximum temperatures different foods can be exposed to without causing damage.

Trainer Note (continued)

Guide the participants through the formulas in the handout, refering to the reference guide on page 1 and encouraging their questions and comments.

Ask how each formula is applied to dryer design.

Explain to those people who are having trouble with the mathematics that there are more general rules of thumb for these same mathematical formulas and that it is not necessary to understand mathematics to design successful solar dryers.

Step 3: 20 minutes
Review and discuss pp. 13 and 14 of the Handout A-1 "Psychrometric Chart". Fashion a simple sling psychrometer and demonstrate its use.

Trainer Note

* Explain wet and dry bulb temperatures and the psychrometric chart.
* To fashion the sling psychrometer, fasten wet gauze to the bulb of a thermometer, tie it to a cord, and twirl the thermometer at the end of the cord.
* Review the psychrometric chart, Handout A-1, pp. 13 and 14.
* Explain that the chart can be used anywhere in the world.
* Demonstrate how the chart can be used to diagram what happens during the drying process (refer to Step C, Handout A-1).

Step 4: 20 minutes
Conclude the session by reviewing the objectives and the reference guide on page 1 of the handout.

Trainer Note

* Explain that the participants now have the necessary technical information for solar dryer design.
* Explain that they will have an opportunity to use this technical information when they design their solar dryers.
* Encourage the participants to think how this information might be communicated to people with little or no formal education.

SESSION #A-2 **SOLAR SITING**

TOTAL TIME: 2 Hours

OBJECTIVES: By discussing the path of the sun and selecting a good solar site, the participants will better understand the importance of proper placement and orientation of solar devices.

By defining heat transfer methods and discussing the heat transfer capabilities of the various materials available for construction, participants will better understand the use and placement of the various materials in solar dryer and storage device design and construction.

MATERIALS: Directional compasses, protractors, string small weights, sun angle charts, sun angle calculator, notebooks, pens, samples of various locally available materials usable in solar dryers, flipchart and markers, model solar dryer (or large detailed drawing of a dryer).

RESOURCES: Handout A2 "Solar Siting"
Handout 10A "Materials and Tools List"
Sun angle chart for proper latitude
Magnetic variation map of the world. U.S.D.O.D.

PROCEDURES:

Step 1: 5 minutes
Review objectives and note procedures.

Step 2: 15 minutes
Distribute the sun angle chart for this latitude and describe and discuss the path of the sun for the specific training location, noting seasonal changes, site considerations, etc.

Trainer Note

If the country is on or near the equator, mention the possibility of an east and west facing collector which will collect solar energy the whole year (as long as the sun shines) and mention that tilted south or north facing collectors will only work half of the year, but all day long. Horizontal collectors will work well all day, all year, but won't produce much air flow, (the hot air won't know which way is up). Point out that the sun angle chart represents a hemisphere opened up onto a two-dimensional piece of paper. Ask which months and what part(s) of the day are usually cloudy and which are sunny.

Step 3: 30 minutes
Refer to Handout A2, "Solar Siting", form work teams, distribute solar site selection materials, go outside to select a solar site and prepare to describe their solar site to the group.

Trainer Note

The handouts should be self-explanatory. Clarify the handouts as necessary. Circulate among the groups as they are performing their solar site selection and offer help. Remind everyone of the magnetic variation for the training site and/or country. Remind people of the time remaining.

Step 4: 10 minutes
Reconvene the large group to discuss findings and answer questions.

Trainer Note

Move from one solar site to the next, with one person from each group explaining why they chose it as a solar site. Share shade maps. Ask for remarks on decision-making methods and group dynamics.)

Step 5: 10 minutes
Define three types of heat transfer, referring to solar dryer designs.

Trainer Note

They are: (1) radiation, electromagnetic energy which can travel through a vacuum (sunlight-to-earth) and from a warm body to a colder body; (2) conduction, heat transfer through a solid; and (3) convection, heat transfer through a fluid such as air or water. Use the model solar dryer or a large drawing of a solar dryer to help illustrate these three types of heat transfer.

Step 6: 20 minutes
Refer to Handout 10A "Materials & Tools List". Discuss which material should be used in which part of a solar dryer and why.

Trainer Note

Discuss how radiation can pass through glazing materials at different rates depending on the material, how air can convect heat through screening material and the importance or unimportance of insulation materials to stop conductive heat transfer. Discuss potentially high cost of large-scale solar crop dryers and how a cooperative or community could afford to build one.

Step 7: 10 minutes
Discuss how the materials list can be used in design session to follow.

Trainer Note

Refer to design session and how a cost limit may be placed on each dryer built. Refer to session on economics for cost-benefit discussion. Ask how a free or extremely low-cost solar dryer could be built.

SESSION #A-3 **PREPARING FRUITS AND VEGETABLES FOR DRYING**

TOTAL TIME: 2 Hours

OBJECTIVES: By researching, reporting and demonstrating the various methods of fruit and vegetable preparation, the participants will gain detailed information needed to meet their expectations of the program.

MATERIALS: Flipcharts, markers, notebooks, pens, cookstoves or burners, cooking pots, blanching equipment, kitchen utensils (knives, bowls, spoons, etc.), blender (if available), soap and water, waxed paper (or equivalent) and other materials, as needed by the participants.

RESOURCES: Handout 2A "Tips for Drying"
Handout 5B "Food Drying Considerations"
Solar Drying in the Tropics
Sun Drying Fruits and Vegetables
Putting Foods By

Trainer Note

This session is not in the Proposed Schedule because it is assumed that the majority of drying and storage training will focus on grains, legumes and fish. However, in the case where fruit and vegetable drying is a felt need of the people in the region and is listed as a major expectation in Session 1, then this session should be scheduled near Sessions 2, 13, 21 or 23. Sometime in the first week would be preferable.

PROCEDURES:

Step 1: 5 minutes
Review the objective and outline the procedures.

Step 2: 40 minutes
In small groups, research improved fruit and vegetable preparation techniques and prepare a report or demonstration.

Trainer Note

Make all of the resources listed and any others located available to the groups. Circulate between groups offering help as a reference. Coordinate any demonstrations among the small groups and the available kitchen equipment. Provide flipcharts and markers to those groups that need them.

Step 3: 60 minutes
Have the small groups report their findings or present their demonstration.

Trainer Note

Facilitate these presentations. Schedule all of the reports together and all of the demonstrations together, to minimize transition time from classroom to kitchen.

Step 4: 10 minutes
Conclude the session by asking for a volunteer to compile all of the information generated during this session into a country-specific handout and/or recipe book.

Trainer Note

Point out that this information can be used in the "Reloading Sessions" repeated throughout the program.

SESSION #A-4 **THE USES OF DRIED FRUIT AND VEGETABLES**

TOTAL TIME: 2 Hours

OBJECTIVES: By researching, reporting and demonstrating the various uses of dried fruits and vegetables, the participants will gain detailed information to meet their regional needs and program expectations.

MATERIALS: Kitchen and cooking utensils (listed in Session A-3). Clear plastic sheeting, candles, storage containers, conditioning containers, clean sheets, oven (or other heat source), thermometers, timepieces.

RESOURCES:
Handout 5C "Food Storage Considerations"
Handout 13A "Tests for Dryness"
Handout 13C "Summary of Temperature Factors"
Handout 13D "Conditioning and Pastuerizing"
Handout 21A "The Use of Vegetable Oils to Protect Stored Beans"
Sun Drying Your Fruits and Vegetables
Preserving Food by Drying
Putting Food By

Trainer Note

This session is not in the Proposed Schedule because it is assumed that the majority of drying and storage training will focus on grains, legumes and fish. However, if information on the uses of dried fruits and vegetables is a felt need of the people in the region and is listed as a major expectation in Session 1, then this session should be scheduled sometime in the second week of training, after a stock of dried foods has been gathered.

PROCEDURES:

Step 1: 5 minutes
Review the objective and outline the procedures.

Step 2: 30 minutes
List as many "Use of Dried Fruits and Vegetables" as possible.

Trainer Note

The list should include the following: rehydrating, cooking, packaging, conditioning, storage, pastuerizing, marketing, etc.

Step 3: 30 minutes
Form a small group for each of the topics listed, research the topic and prepare a report or demonstration.

Trainer Note

Be sure everyone who is interested is in a small group. Suggest that people join a group in which they either have an interest or past experience. Make the resources available to the groups. Circulate among the groups offering help. Coordinate any demonstrations among groups and with the available equipment and materials. Provide flipcharts and markers as needed.

Step 4: 60 minutes
Have the small groups present their report or demonstration.

Trainer Note

Facilitate these presentations. Schedule the reports together and the demonstrations together to reduce transition time from classroom to kitchen (if applicable).

Step 5: 10 minutes
Conclude the session by asking for a volunteer to compile and reproduce the information generated during this session into a handout, poster or booklet.

Trainer Note

Point out that this session's information should be used throughout the remainder of the program and incorporated into the presentations of devices (Session 29).

SESSION #A-5 **PROBLEM SOLVING**

TOTAL TIME: 2 Hours

OBJECTIVES: By using a tool to solve a current problem encountered in the training program, the participants will gain problem-solving skills applicable in development work.

MATERIALS: Flipchart and markers, notebooks and pens.

RESOURCES: Handout A-5 "The OFPISA Problem Solving Model"

Androgogy Ingalls, J. pp. 38-45, 145, 146
A Handbook of Structured Experiences for Human Relations Training Pfeiffer and Jones

Trainer Note

In the event that a problem arises in the training program which has an effect on the program itself, the trainer may want to use this session to facilitate solving that problem so that the training program can continue. This session is not scheduled into the program, although the information in the Handout can be very helpful in community work and interpersonal situations. It is up to the trainer to decide when this session is needed, if at all. If the session is not needed, the Handout may be refered to for future reference.

PROCEDURES:

Step 1: 5 minutes
Review the objectives and outline the procedures.

Step 2: 15 minutes
Distribute Handout A-5, read, discuss and have the participants suggest a sample problem.

Step 3: 60 minutes
In pairs work through the problem, using the OFPISA model.

Step 4: 20 minutes
As a group, develop a plan for improvement or solution, using the information generated in Step 3.

Step 5: 15 minutes
As a large group, elicit questions and discussion about the activity and the model.

Step 6: 5 minutes
Conclude the session by referring to the evaluation process of the training program, discuss how problem-solving and evaluation are important factors in development work and set a time for reviewing the plan developed in Step 4, to check on the acceptance of the solution to the problem.

LIST OF HANDOUTS

Handout Number	Handout Title
1A	Proposed Training Program Schedule
1B	Session Descriptions
1C	Introduction To Training
1D	Blank Two-Week Schedule
2A	Tips for Drying
2B	Data Collection Sheet
3A	Food Drying and Storage Community Assessment Questions
3B	Guidelines for Community Assessment
4A	Sample Food Drying and Storage Timeline
5A	A Catalog of Dryers and Stores
5B	Food Drying Considerations
5C	Food Storage Considerations
6A	Smoke Test Data Collection Sheet
7A	Effective Group Survey
7B	The Decision-Making Process
7C	Feedback and the Helping Relationship
8A	Non-Formal Adult Education
8B	Extension, Training and Dialog
10A	Materials and Tools List
12A	Guidelines for Process Observer
13A	Tests for Dryness
13B	Percent Moistures for Grains and Legumes
13C	Summary of Temperature Factors
13D	Conditioning and Pastuerizing
14A	Sample Cost/Benefit Analysis of a Solar Dryer
14B	Lifecycle Unit Cost Analysis of a Solar Dryer
14C	Economic Comparison of Two Maize Stores
17A	Mid-Program Evaluation
17B	Blank One-Week Program Schedule
17C	Coat of Arms
18A	A Partial List of NFE Activities
18B	Some Guidelines for Motivating and Teaching Groups
18C	Role-Play Guidelines for Extension Workers
18D	People's Theater
20A	Evaluation of Method Demonstration
20B	Planning a Method Demonstration
20C	Method Demonstration Guidelines
21A	Use of Vegetable Oils to Protect Stored Beans
26A	Evaluation Checklist for Dryers and Stores
27A	Program Evaluation
27B	Appropriate Technology Information and Resource List
27C	Descriptive Bibliography of Recommended Texts
27D	Solar Drying and Improved Food Storage Bibliography
30A	Certificate of Completion
A1	Technical Solar Dryer Design Information
A2	Solar Siting
A5	The OFPISA Problem-Solving Model

PROPOSED TRAINING PROGRAM SCHEDULE

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8	1) Introductions and Scheduling	4) Timeline	8) Adult Learning	12) Facilitation Skills	14) Economics	16) Other Technologies
10	2) Tour of Solar Dryers.	5) Design Considerations	9) Natural Cooling and Rainy Season Drying	13) Unload dryers	15) Storage Pests and Their Control	17) Mid-Program Evaluation
12						
2	3) Community Assessment	6) Smoke Tests 7) Model Design and Construction	10) Design of Dryers and Stores 11) Construction	11) Construction	11) Construction	(Optional Construction)
4						
6						

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8	18) Introduction to Non-Formal Education	20) Introduction to Method Demonstrations	22) Local Development Projects	24) Chemical and Non-Chemical Pest Control	27) Program Evaluation	
10	19) Non-Formal Education Presentations	21) Practicing Method Demonstrations	23) Independent Study	25) Action Plan	28) Preparation of Presentations	
12						
2						
4	13) Unload, reload 11) Construction	13) Unload, reload 11) Construction	13) Unload, reload 11) Construction	13) Unload, reload 26) Assessment and Modifications	29) Presentation of Devices	
6					30) Wrap-up	

HANDOUT 1A

Session Descriptions

These session descriptions provide a brief outline of each session offered in this training program, the length of each session and whether it is an extension, extension practice, technical or technical practice session. They are listed in chronological order, as they appear on Handout 1A, "The Proposed Training Program Schedule". When using this list to rewrite the schedule, be sure to balance classroom sessions with outdoor sessions, take weather patterns (morning clouds, afternoon rains, etc.) into account and include enough sessions to make the program meet your needs.

Session Number	Number of Hours	Session Title and Description
1	2	Introductions and Scheduling (extension). Interviewing and identifying resources within the group, introductions, listing expectations and scheduling at least the first week of the training program.
2	2	Tour of Solar Dryers (technical practice). Evaluate existing dryers and stores for applicability and usefulness, prepare foods and load the dryers. Loading the dryers is repeated during the program.
3	4	Community Assessment (extension practice). List community assessment questions, perform an assessment, prepare a report and report back to the group.
4	2	Timeline (technical). Develop a dryer and storage timeline for each climatic zone of the country, noting temperature, humidity, crop prices, planting and harvest times, wet and dry seasons.
5	2	Design Considerations (technical). Discuss advantages and disadvantages to traditional methods, reviewing slides and a catalog of dryers and stores from around the world, discussing detailed considerations.

Session Descriptions

6	1	Smoke Tests (technical practice). Perform experiments to discover the relations between solar dryer design variables.
7	3	Model Design and Construction (technical practice). Design and build dryer and storage models and present the designs to the group.
8	2	Adult Learning (extension). Look at how adults learn best, the methods used in the training program and how adult learning can be used in the villages.
9	2	Natural Cooling and Rainy Season Drying (technical). Research and discuss these other types of drying and storage before the design and construction sessions.
10	2	Design of Dryers and Stores (technical practice). Develop a complete design of a dryer or store that can be built during the training program.
11	22	Construction (technical practice). Build the device designed in Sesson 10. The 22 hours is spread over 6-7 days.
12	2	Facilitation Skills (extension practice). Develop a list of effective facilitation criteria as a group. The list will be used throughout the program and in extension work.
13	2	Unload dryers (technical practice). Unload the dryers (from Session 2), test for dryness and reload the dryers. This session repeats.
14	2	Economics (technical practice). Comparing city and country economics research and deliver an economic presentation.

Session Descriptions

15	2	Storage Pests and Their Control (technical practice). Research and report on mold, insect and rodent food damage, control and prevention.
16	2	Other Technologies (technical). Discuss technologies other than dryers and stores to meet the expectations of the group.
17	2	Mid-Program Evaluation (extension). Look back at the first week and reschedule the second week, if necessary.
18	2	Introduction to Non-Formal Education (extension). Observing and discussing different NFE techniques that can be used at the village level.
19	2	Non-Formal Education Presentations (extension practice). Present the NFE activities developed in small groups.
20	2	Introduction to Method Demonstrations (extension and technical practice). Observing and participating in a technical method demonstration that transfers pest control information. Prepare a method demonstration.
21	2	Practicing Method Demonstrations (technical and extension pratice). Presenting and participating in method demonstrations.
22	2	Local Development Projects (extension and technical). Discuss and critique local technical and community development projects. Volunteers from the group present their own projects.
23	2	Independent Study (technical or extension practice). Research or practice a technical or extension topic that isn't covered in the program.

Session Descriptions

24	2	Chemical and Non-Chemical Pest Control (extension practice). The group decides what is needed in the area of pest control and coordinates the session.
25	2	Action Plan (extension practice). Look ahead 3 and 6 months and explain how you will implement the information from the program.
26	4	Assessment and Modification (technical practice). Test and improve the devices built during the program.
27	1	Program Evaluation (extension practice). Look back at the program and provide feedback to the trainers on the good and bad parts. Review resources and bibliographies.
28	3	Preparation of Presentations (extension practice). Prepare a non-formal education activity to present the devices built during the program to the group.
29	3	Presentation of Devices (technical and extension practice). Present the devices built, answer questions and receive feedback.
30	1	Wrap-Up (extension). Announcements, certification ceremony and final clean-up of the construction site and tools.

Session Descriptions

Optional Sessions

A1	2	Technical Solar Dryer Design Information (very technical). Review and discuss technical design information, psychrometric charts and sample calculations.
A2	2	Solar Siting (technical practice). Learn where to place a solar collector (such as a solar dryer) so that it won't be shaded by buildings or vegetation.
A3	2	Preparing Fruits and Vegetables (technical practice). Research, report and practice the details of preparing fruits and vegetables for loading into a solar dryer.
A4	2	The Uses of Dried Fruits and Vegetables (technical practice). Research, report and practice rehydrating, cooking, packaging, conditioning, pastuerizing and storage of dried foods.
A5	2	Problem Solving (extension practice). Solve a problem that is causing difficulties in the program so that the program can continue.

Introduction to Training

There are two threads running through this training program: one of technical training, in the areas of food drying and storage, and one of extension training, in the concept of appropriate technology community development

The main focus of the program, of course, is the technical training of Peace Corps Volunteers and their Counterparts, to be able to design, build, use and maintain improved food dryers and stores. But from an extension standpoint, the technologies themselves will not do anyone any good if they are not presented as community development tools. The community development philosophy that has been inherent in CHP/Farallones training programs over the years is one that takes people into account and builds on what they know to help them solve their own problems.

Technologies that do not take a people and their culture into account are doomed for failure and it does not take long to develop a list of improperly introduced technologies. But technologies that use locally available resources, both human and materials, to meet community-felt needs, have a good chance of succeeding and growing. Improving traditional technologies is more acceptable to a community than importing completely foreign ones. Technologies are only tools with which true community development work can proceed.

This training program is designed to model and parallel community extension work. Participants are asked to take a full and active role in their own education. They are urged to cooperate with others to identify and use the talents and resources that are available to the group and to practice skills that help motivate people, instill within them a feeling of self-confidence and involve them in the process of their own education.

The approach to training is based on the principles of non-formal education and is designed to strike a balance between structured learning and guided, yet independent discovery. The sessions, resources and methods that are included reflect the belief that people are capable of self-direction and creativity when encouraged to apply their knowledge and skills in ways that are relevant to their lives. It is the intent of the program to offer a framework to the participants to apply what they have learned in training to service in their own communities.

Introduction to Training

This program offers skill training in all stages of technical development: the design, construction operation, maintenance, evaluation and modification of prototype devices. The designs selected will be as consistent as possible with the realities of rural areas in most parts of the world and are based on the following criteria: affordable and low in capital investment, simple and adaptable in both design and scale, easily understood by people with little or no formal education, responsive to local needs and capabilities, able to be constructed, operated, maintained, repaired and managed by the users, based on the use of renewable sources of energy and local resources, both human and material and characterized by the potential to contribute to local cooperation, self-reliance and good health.

Throughout the program, there is a focus on the principles and techniques of non-formal education and adult learning, methods and approaches to solving problems, development issues, cross-cultural perspectives and the process of assessment and evaluation.

Blank Two-Week Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8						
10						
12						
2						
4						
6						

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8						
10						
12						
2						
4						
6						

Handout 1D

Tips for Drying

Operation of a dryer is not complex, but requires conscientious, systematic attention. Each operator should develop a satisfactory method of drying to match her or his climate, daily schedule and type of food. The following guidelines will help establish a successful system:

1. Choose fresh, sound, firm and ripe foods. Do not use over-ripe foods. Weigh food and record weights.

2. Wash fruits, vegetables and roots before drying. Scrub, if necessary.

3. Slice fruits, vegetables and roots into thin, uniform pieces, less than 1cm thick. Cut and prepare foods quickly. Keep foods clean.

4. Prepare other foods by shelling, hulling, peeling or slicing. Threshed grains dry faster than whole heads. Smaller pieces dry faster. Some foods dry better if blanched first (i.e., potato, cassava, yams, etc.).

5. Spread foods evenly on drying racks. Thinner layers dry faster. Load dryer at 10kg of food per square meter of tray when using a pre-heater and 5kg of food per square meter, when using a dryer without a pre-heater.

6. Cover food to keep out insects which could lay eggs in or on drying foods. Keep out animals, dirt and children.

7. Dry food with warm, dry, circulating air. Stir or turn foods 2-3 times per day to promote even drying.

8. Test for dryness after three days. Food is "dry for storage" when dried weight is 1/5 or fresh weight, in the case of fruits and vegetables; 3/4 of fresh weight in the case of grains and legumes. Dehydration time depends on humidity of the air, type of food, food moisture, percent sunshine, etc.

9. Use a thermometer to maintain optimum drying temperatures by manipulating outlet vent damper. Check dryer temperature at hottest part of the day and set damper to give best drying temperature.

10. Condition food in large containers lined with clean cloth for 1-2 weeks. (See Handout 13D.)

Tips for Drying

11. Pasteurize at 80°C for 10-15 minutes or 57°C for an hour to kill eggs and larvae. This also destroys the germination possibility of grains and legumes as seed.

12. Store dry fruits and vegetables in small, airtight, moisture, insect and rodent proof containers in dark, cool, dry and clean places. Store grains, roots, and legumes in places with good air circulation.

Specific Drying Tips

(See Handout 13C for "Maximum Temperatures of Food, Feed and Seed.)

Beans:	Scratch surface with a wire brush to speed drying. Boil for 2 minutes, drain, spread evenly to dry. Optimum/maximum temperatures: 55°C/70°C.
Ground Nuts:	Remove dirt from shells. Dry in shell or out of shell. Do not expose to extreme heat. Optimum/maximum temperatures: 30°C/35°C.
Yams, potatoes:	Wash, peel, slice, grate or shred.
Cassava:	Use local drying procedure to remove poisonous or toxic substances.
Maize:	Remove husks, dry 2-4 cobs thick. Or shell cobs and spread 4-15cm thick. Optimum/maximum temperature: 40°C/45°C.
Squash seeds:	Separate from stringy material, rinse, spread evenly.
Coconut:	Place half coconut, cut side up, for a day, then remove meat from shell, cut up or grate to continue drying.
Cocoa:	Ferment beans, spread evenly and turn once or twice a day until dry.
Fish:	Split in half, if large. Dry in the shade (out of direct sun) to reduce color changes. Keep below 55°C to avoid cooking.

Tips for Drying

Coffee:	Use ripe berries only. Spread single layer thick.
Banana, Mango:	Use ripe fruit, slice 1/2cm thick, spread one layer thick, turn 2-3 time per day, do not over-dry.
Rice:	Dry down to 18% moisture within 2 days of harvest (easily done by air-drying) and to 13-14% within a week (using a drying mat, platform, floor or improved dryer). Do not dry too quickly or cracking will occur.

Solar Dryer Date Collection Sheet

Type of Food:
Preparation of Food:
Placement of Dryer:
Type of Storage:

Date	Time	Weight	Outside Air Temp.	Dryer Temp.	Vent	Outside Humidity	Weather	Comments

Food Drying and Storage Community Assessment

In order to determine if or how solar dryers and improved food storage devices are appropriate technologies that meet a community-felt need, it is necessary to find answers to the following questions, plus other questions you may determine as necessary.

1. What foods are commonly dried:

2. What time of year does drying occur for each of the foods listed in number 1:

3. How long does each food take to dry:

   Under sunny conditions:

   Under cloudy conditions:

4. Are there any problems with traditional drying methods?

5. What are the local tests for dryness:

6. How is each type of food stored:

7. How long does each type of food last in storage:

8. Are there any problems encountered with stored dried foods:

Food Drying and Storage Community Assessment

9.

10.

11.

12.

13.

Guidelines for Community Assessment

In teams of 2-4, use community assessment techniques, such as questionnaire, interview, observation, conversation or a combination of these to gather information about the food drying and storage methods and procedures used in this area. In gathering the information, please follow these guidelines:

- All team members should participate actively in all phases of the exercise.
- Information gathering should be conducted in a sensitive and careful manner (always ask permission). Don't prowl or intrude.
- Concentrate on using appropriate communication skills: respect others' privacy and values. Listen and report accurately, be patient, report facts, not what you wish you had found.
- Limit the scope of the assessment or you may be overwhelmed.

Your report should include:

- A summary of data collected.
- A copy of questions asked.
- Methodology used.
- Resources consulted during the assessment.
- Suggestions for improving the assessment.
- Recommendations for improving food drying and storage using methods that are within cultural and economic restraints of the community.

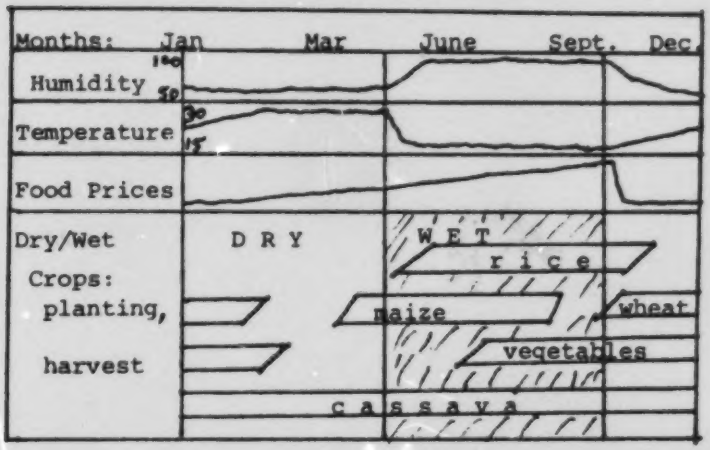
SAMPLE FOOD DRYING AND STORAGE TIMELINE

Introduction:

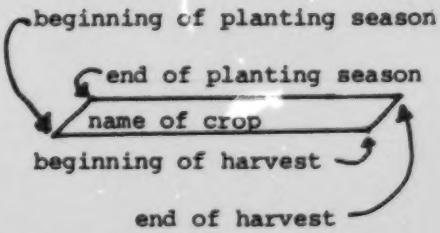
This sample timeline shows one way to present a large amount of information in a brief form. It shows:

1. The Humidity Levels during the year
2. The Temperatures during the year
3. Food Prices during the year
4. Wet and Dry Seasons, and
5. Planting, Growing, and Harvest times

SAMPLE FOOD DRYING AND STORAGE TIMELINE



How to read the planting and harvesting times:



What this timeline tells us:

1. The wet season is generally from May through September
2. The humidity is low during the dry season (60%) and high during the wet season (90%)
3. The temperature is warm (30°C) during the dry season and cool (15°C) during the wet season.
4. Food prices drop at the end of the rainy season when crops begin to come in, then steadily rise all year.
5. Rice is planted at the beginning of the rainy season and harvested at the beginning of the dry season, a good candidate for a solar dryer and improved store.
6. Some farmers double crop maize and wheat. The maize would need a rainy season dryer because of its harvest time. The wheat could be solar dried.
7. Vegetables, grown during the wet season, could be sun dried.
8. Cassava is planted and harvested year-round

CATALOG OF DRYERS AND STORES

Fig. 1 Traditional hut-roof fish drying, Zambia

Fig. 2 Traditional drying on ground and raised platforms, India

Fig. 3 Traditional vegetable drying under roof eaves, Nepal

Fig. 4 Traditional sun-drying of rice, Java

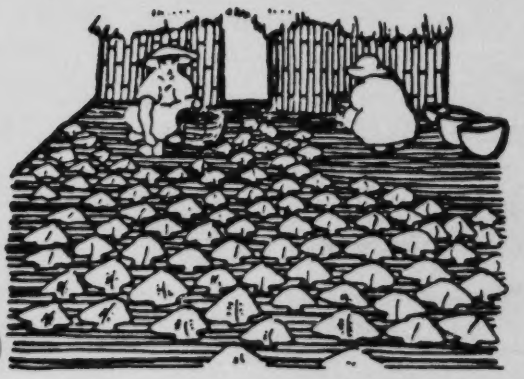


Fig. 5 Sun drying salted catfish, Cambodia

Fig. 6 Traditional food dryers, Kenya

Fig. 7 Traditional dryer/storage in attic of cookhouse, Kenya

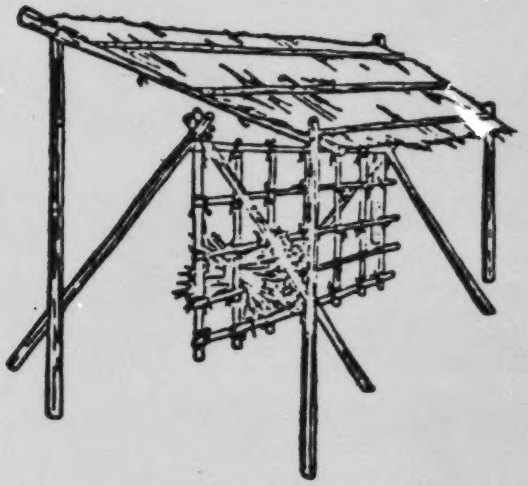


Fig. 8 Improved post-harvest air-dryer for rice, Sierra Leone

Fig. 9 Fish smoker, Ivory Coast

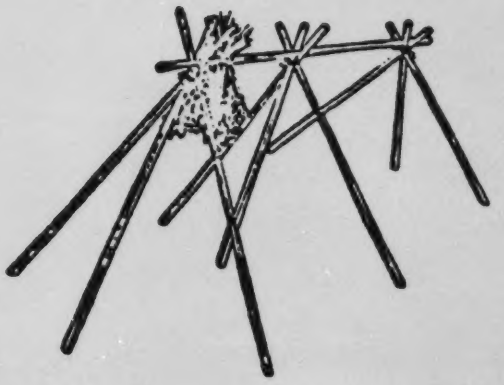


Fig. 10 Improved post-harvest air-dryer for rice, Sierra Leone

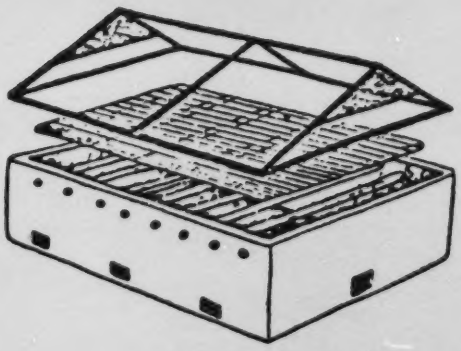


Fig. 11 Improved VITA solar dryer

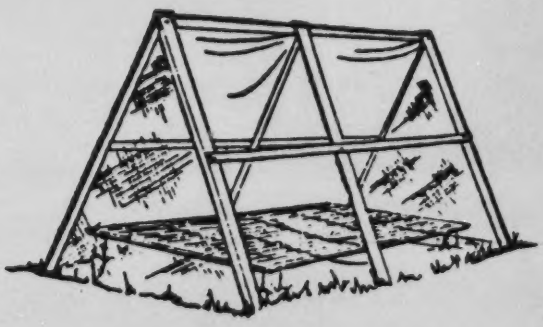


Fig. 12 Solar tent dryer, Philippines

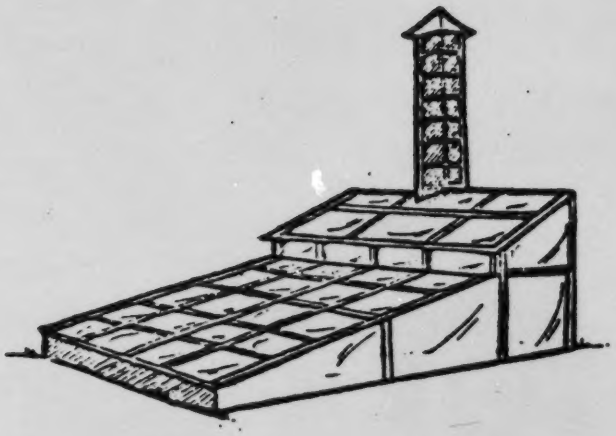


Fig. 13 International Rice Research Institute solar rice dryer, Thailand

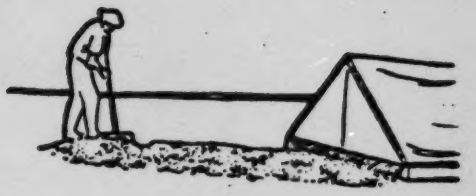


Fig. 14 Concrete drying floor with foul weather cover, Columbia

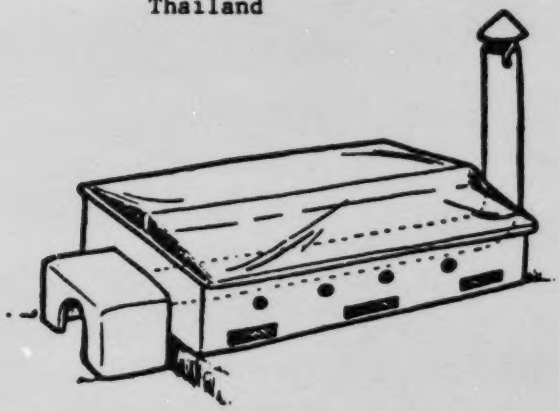


Fig. 15 VITA solar dryer with fuel-fired rainy season dryer attached

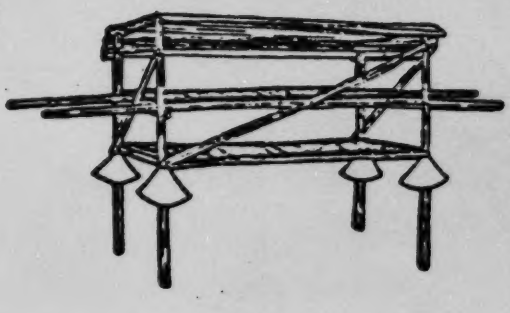


Fig. 16 Improved air dryer/store, Sierra Leone

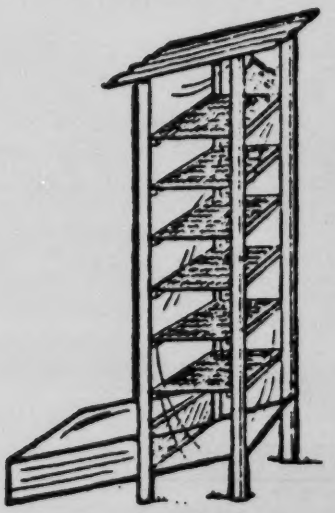


Fig. 17 Solar "chimney" dryer with pre-heater

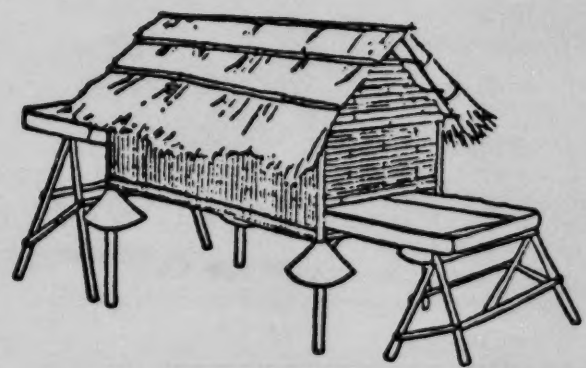


Fig. 18 Improved air-dryer for cocoa and coffee, Sierra Leone

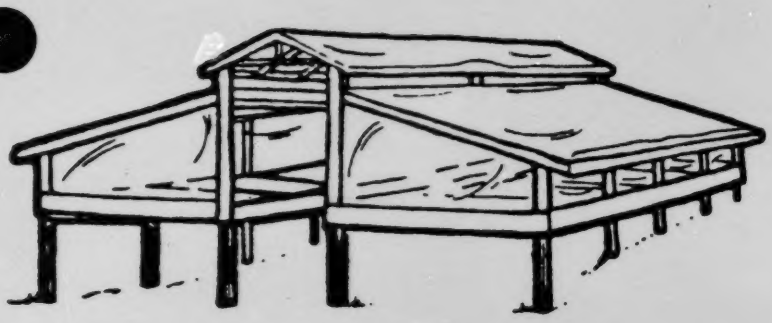


Fig. 19 Walk-through, plastic-covered, solar coffee dryer, Columbia

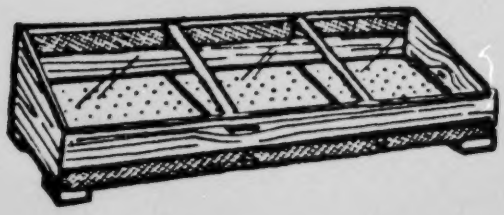


Fig. 20 Solar cabinet dryer, Syria

Fig. 21 Plastic-covered concrete drying floor for coffee, Columbia

Fig. 22 Plastic-covered, walk-through solar coffee dryer, Columbia

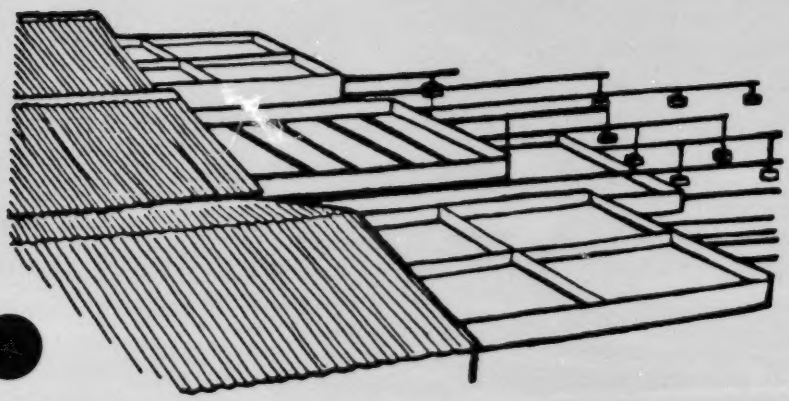


Fig. 23 Pull-out, rolling carts for drying coffee, Columbia

Fig. 24 Solar cabinet dryer, Indonesia

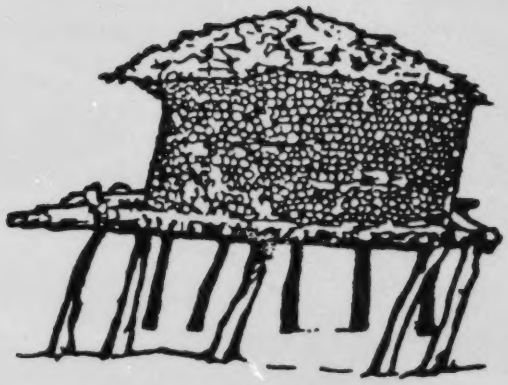


Fig. 25 Traditional corn barn, Ghana

Fig. 26 Traditional Gottera, Ethiopia

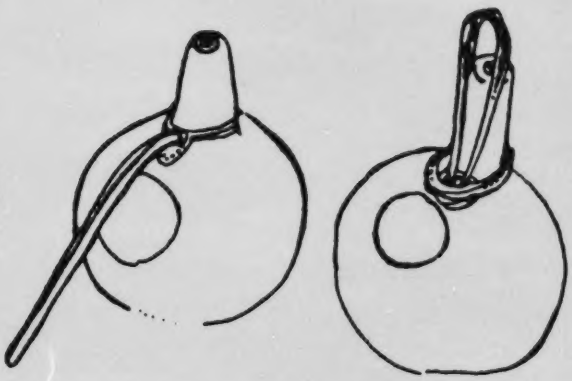


Fig. 27 Traditional calabash seed stores, Kenya

Fig. 28 Improved dry-store hut, Benin

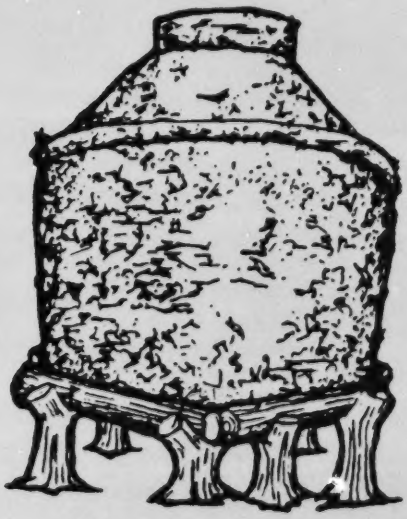


Fig. 29 Traditional muddied basket, Chad

Fig. 30 Traditional muddied stores, West Africa

Fig.31 Traditional Kamba grain store, Kenya

Fig. 32 Traditional grain store, Kenya

Fig. 33 Traditional covered basket store, Kenya

Fig. 34 Improved Ghana grain silo

Fig. 35 Improved muddied basket with rat guards, Kenya

Fig. 36 Traditional Kipsigis grain store, Kenya

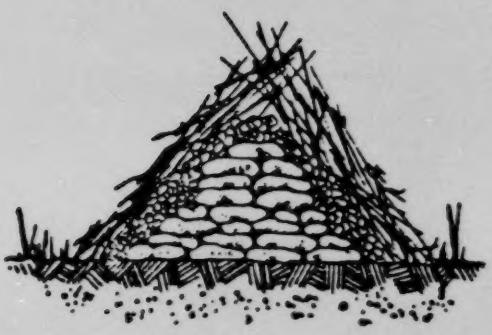


Fig. 37 In the field potato clamp

Fig. 38 Yams tied to poles and trees for drying and storage

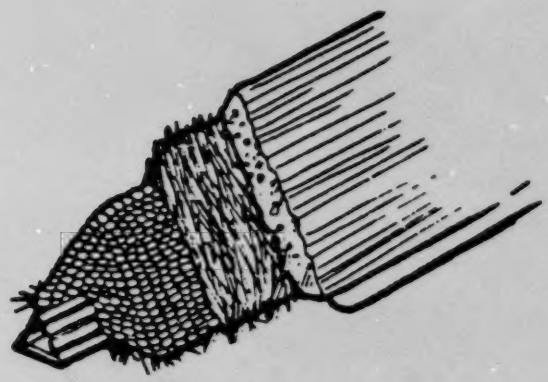


Fig. 39 Improved potato clamp with air circulation tube

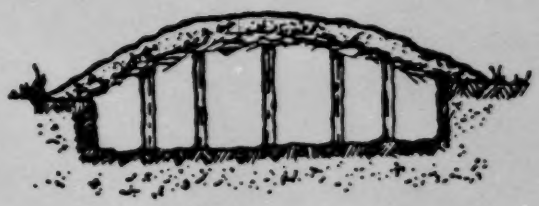


Fig. 40 Semi-subterranean potato storage house

Fig. 41 Improved maize crib built from local materials

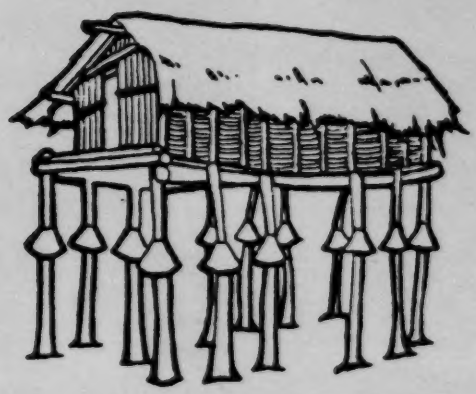


Fig. 42 Dungu, improved with rat guards, Tanzania

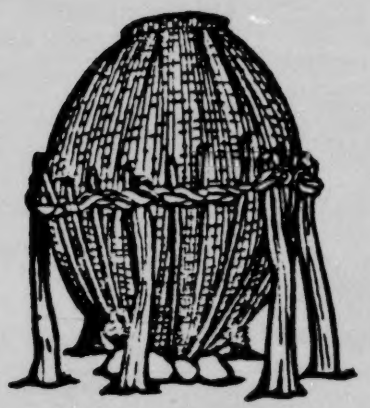


Fig. 43 Traditional grain storage basket, Ivory Coast

Fig. 44 Improved grain sack storage inside warehouse

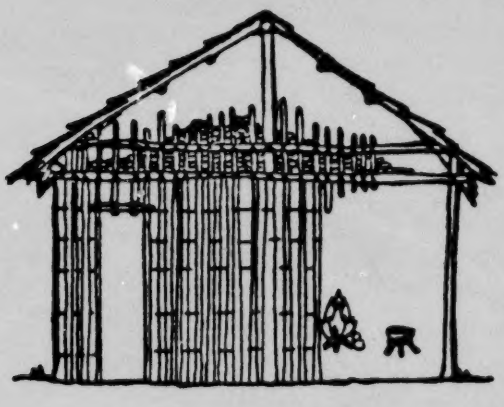


Fig. 45 Traditional attic storage, Tanzania

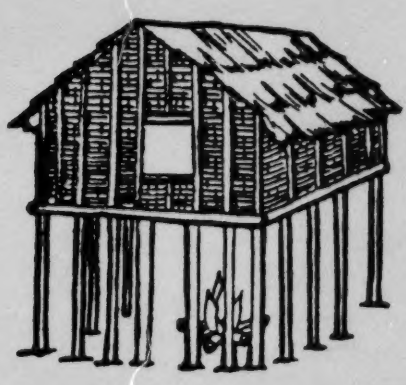


Fig. 46 Traditional Dungu, Tanzania

Fig. 47 Traditional grain drying and storage

Fig. 48 Traditional store improved with rat guards

Fig. 49 Traditional raised rice stores, Laos

Fig. 50 Traditional nkhokwe improved with rat guards and muddying, Malawi

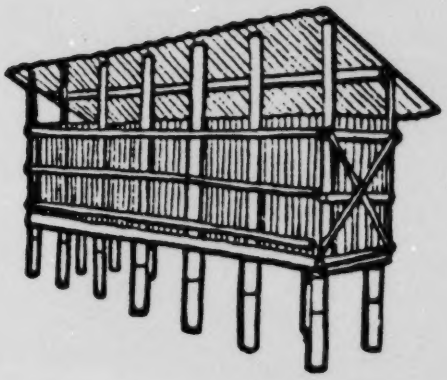


Fig. 51 Improved maize crib built from local materials, Nigeria

Fig. 52 Hygenic rice store, China

Fig, 53 Improved crib built from imported materials, Swaziland

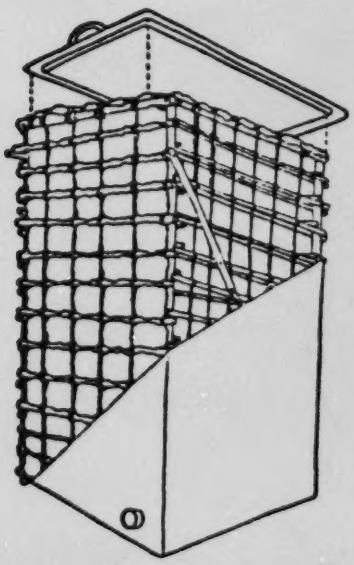


Fig. 54 Air-tight wattle and daub

Fig. 55 Air-tight brick silo, Tanzania

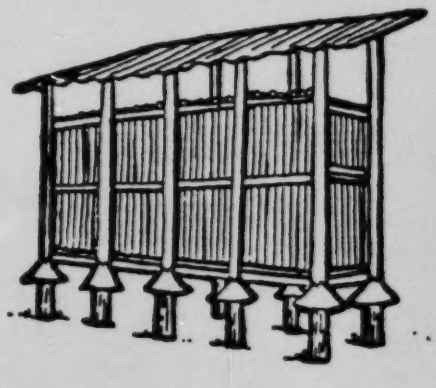


Fig. 56 Maize crib, improved with rat guards, Nigeria

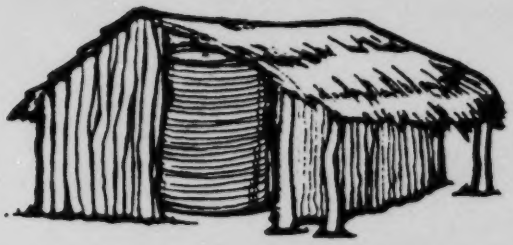


Fig. 57 Metal grain tank with thatch roof, Swaziland

Fig. 58 Imported steel grain silo, Benin

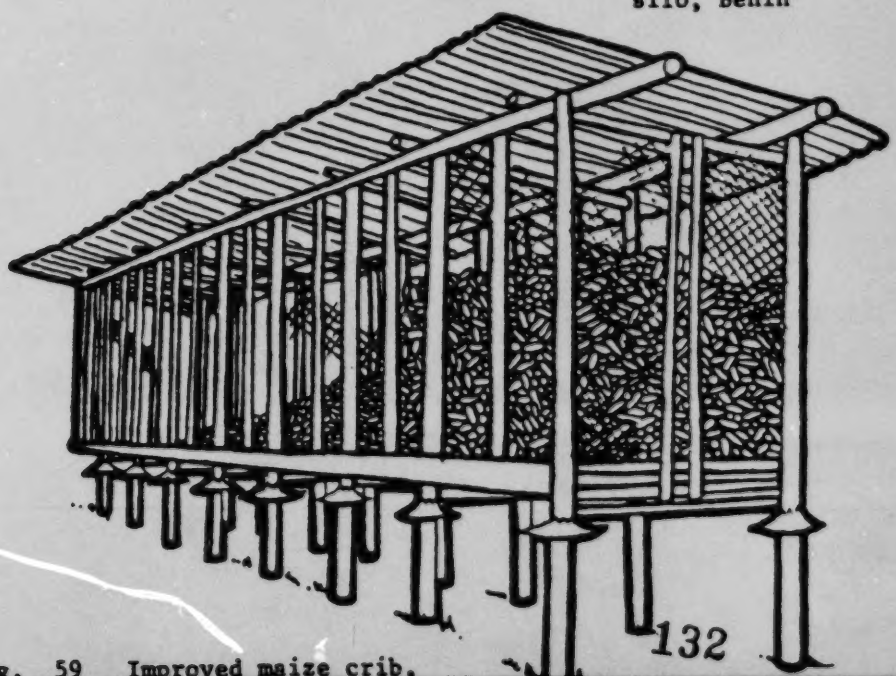


Fig. 59 Improved maize crib,

Descriptions of the Dryers and Stores

Fig. 1: In Zambia, fish are split in two and placed on hut roofs in the morning. They take one or two days to dry. Placing them on the roof keeps them away from animals, children and ground dust.

Fig. 2: Drying on tarps, mats, or plastic sheets can be found all around the world. Some areas will have specially made concrete drying floors. By raising the food off the ground, using platforms, air is allowed to pass up through the food and it dries somewhat faster.

Fig. 3: By hanging vegetables (mostly onions, garlic and peppers) under the eaves on south-facing walls, the Nepalese take advantage of the sun, avoid the rain and keep their foods away from the dirt, animals and people on the street.

Fig. 4: In Java, rice is threshed soon after harvest and spread on raised mats. The children are responsible for turning the rice so that it will dry faster.

Fig. 5: Cambodians salt their catfish (which draws some moisture out of the fish and also preserves it from bacterial infection) then split them open and spread them on decks to dry.

Fig. 6: Inverted cones, made from wooden sticks, catch a large percentage of the sun's light in Kenya because that country is on the equator. The food is placed on the inside of the cone to keep it away from animals and children.

Fig. 7: By placing foods (usually grains, maize) in the attic of a cookhouse, the heat from the smoke dries the food while the smoke repels insects. The food takes on a smoke smell and flavor, which is favored by some and disliked by others.

Fig. 8: This air-dryer will hold many "ties" of rice after it is harvested so that the rice does not have to be stacked up in the field where it can easily mold. The device is made from local "bush poles" and can be covered by a thatch roof to keep off rain during the wet-season harvest.

Descriptions of the Dryers and Stores

Fig. 9: The typical "banda" of West Africa uses a large amount of wood to smoke a small amount of fish (usually 6kg wood per 10kg fish). Smoking dries the fish, repels insects and adds flavor.

Fig. 10: A simpler model of Fig. 8. This can easily be set up, taken down and the horizontal poles can be carried home, loaded with "ties" of rice.

Fig. 11: The standard VITA dryer has small inlet vents near the ground and virtually no high outlet vents. It can be improved by giving it larger inlet vents and large, screened vents at either end of the single-glazed roof.

Fig. 12: The Philippines solar tent dryer is low-cost and easy to build and operate. It can be improved by making all of both ends of the dryer screened. One of the plastic sides can be made with black plastic (especially for fish).

Fig. 13: The IRRI dryer can dry 400 kilograms of paddy in three or four days, depending on the weather conditions. The outlet chimney can be made larger to improve air flow. The plastic must be replaced as it wears out (about 1-3 times/year).

Fig. 14: Coffee (or other foods) can be stirred to maximize drying. At night and in case of rain, it can be pushed under the "tent" to minimize spoilage.

Fig. 15: Here the VITA dryer has been improved with a fuel-fired "stove" attached so the smoke - and heat - travels through the dryer, under the foods and exits through the stovepipe at the other end. The smoke does not flow through the food.

Fig. 16: This improved dryer/store has a removable roof that can be placed on the "handles" at either end to increase the drying tray area. The roof can be replaced at night or during rain and the rat-guards keep away the rats.

Fig. 17: This dryer has a fairly small solar collector/pre-heater for the number of trays inside, but the clear sides would act to collect solar energy also, thus improving performance. In a warm climate this dryer would work well.

Descriptions of the Dryers and Stores

Fig. 18: This dryer was made totally from local materials. The trays slide out during the day and slide under the roof cover at night and during rainy periods.

Fig. 19: This dryer makes an improvement over the raised platform by covering it with plastic. Air rises up through the slatted tray bottoms, the food is raked to improve drying and there is no need to worry about rain.

Fig. 20: a small, direct-gain solar dryer with low inlet vent in front and high outlet vent in back.

Fig. 21: A variation on Fig. 19. If this dryer becomes much more enclosed, some people will refuse to enter because of the high temperatures.

Fig. 22: An interior view of a dryer similar to Fig. 19. Note the stirring rake and the storage cupboards under the drying trays.

Fig. 23: These large trays roll out from under their cover in the morning and roll back at night and in case of rain. Several levels of trays allow a large quantity of food to be dried or stored at once.

Fig. 24: Simple design, easily made from local "bush poles", with mosquito netting trays and vents, surrounded with plastic. Stands about 1-1/2 meters high.

Fig. 25: Maize is stacked neatly around the perimeter, butt out, with the majority of the cobs randomly stacked inside. The roof is lifted to remove maize.

Fig. 26: A basket, resting on a stone, covered with a thatch roof. Could be improved by raising it off the ground, muddying the basket and securing the roof to protect from birds. Rat-guards should be placed on the legs, 1m high.

Fig. 27: Calabashes come in all sizes and can be grown in just about any shape if trained early. Their shape makes them almost rat-proof and if the "fill-hole" is well-sealed, it is virtually airtight.

Fig. 28: This store could still be improved by raising it at least one meter, giving it rat-guards and a tight-fitting door.

Descriptions of the Dryers and Stores

Fig. 29: Chad is a very dry place, so moisture is not that often a problem. This woven basket has been muddied and tightly sealed.

Fig. 30: Individual stores in a communal setting. These are only one meter high at the peak of the roof. Many small stores reduces risk of large-scale damage.

Fig. 31: A woven basket, raised off the ground to reduce ground-moisture migration and protected by a large roof. Small entrance at top increases security.

Fig. 32: Similar to Fig. 31, cylindrical basket, raised up on rock footings, with wide, overhanging thatch roof.

Fig. 33: This store can hold 1,000 kg. of maize on the cob, which is why it is not raised too high off the ground. The door is not protected from birds or rats.

Fig. 34: This cylindrical, plastered mudblock silo rests on concrete pillars with sheet plastic between the pillars and the silo to reduce moisture migration. The ferro-cement lid is "cemented" into place with termite mound material.

Fig. 35: An improvement over Figs. 31, 32 and 33: raised one meter, thorn rat guards, sealed top, with tight-fitting, locking, outlet "spout".

Fig. 36: A typical maize crib or barn, for storing field-dried cobs. This one could be improved by building no wider than 1-1/2 meters to allow good air flow.

Fig. 37: Potatoes should be kept moist, cool and dark. This clamp keeps off rain and sun, but keeps the potatoes in contact with the earth.

Fig. 38: Yams store well in humid climates by being tied in the shade of trees. This method also allows for easy inspection.

Fig. 39: The clamp in Fig. 37 could be improved by adding a horizontal air tube to allow carbon dioxide to escape to minimize rotting.

Descriptions of the Dryers and Stores

Fig. 40: A large-scale clamp can be built more permanently using posts to support the insulated thatch roof. The large surface area of earth moderates the temperature and humidity inside this store house.

Fig. 41: Improving the maize crib in Fig. 36 by raising it higher and building it narrower. It could still use rat-guards and a slightly improved roof.

Fig. 42: In the book Appropriate Technology for Grain Storage, it shows how one community solved their own storage problems by fitting their large-scale dungus with rat guards and raising them off the ground.

Fig. 43: They say the shape of this basket doesn't allow rats to run up its sides but they could still run up the legs. Could be improved in at least 4 ways.

Fig. 44: When stacking bags of grain in a warehouse, keep them off the ground with bush poles or perfectly sound sheets of plastic, to reduce moisture migration from the ground (even if it's a concrete floor).

Fig. 45: The cooking fire provides smoke and heat, but the grain is still susceptible to birds and house rats.

Fig. 46: A fire could be lighted under this dungu any time the grain became moist or moldy-smelling. One type of a rainy season dryer. Needs rat guards.

Fig. 47: This cut-away view shows maize being stored and dried in the attic of this cookhouse. The thatch roof allows the smoke to filter up through the maize, then through the roof (which also preserves the thatch).

Fig. 48: Raising a traditional woven basket off the ground at least one meter, providing rat guards and a good roof substantially improved this store.

Fig. 49: These large rice stores (4-6 tons of rice per store) in Laos are fairly well protected. Rats can easily climb ladders, however, so they should be stored away from the storage areas when not in use.

Descriptions of the Dryers and Stores

Fig. 50: Traditionally, these baskets are placed on the ground, but have been improved in several ways as shown here.

Fig. 51: This crib is narrow enough, but the roof overhang is not large enough and the rat guard "sleeves" attached to the legs have been shown to be ineffective: rats can jump over them. The conical guards are improved versions.

Fig. 52: These storehouses are on a large concrete pad. An intact piece of plastic is laid down, bags of rice are stacked on the plastic and eventually covered with woven mats. The area is kept clean to keep from attracting rats. Fumigants and insecticides can be applied easily.

Fig. 53: A well-built crib. The cost could be reduced by using local materials.

Fig. 54: This airtight, wattle and daub grain store has cement plaster inside and out to reduce moisture migration. The lid is sealed with termite mud. The spout is a tin can with a tight-fitting, resealable top.

Fig. 55: This silo is similar to Fig. 34. Sitting on a stone foundation to reduce moisture and painted white or whitewashed to reflect sunlight reduces the temperature fluctuations and, therefore, condensation inside the store.

Fig. 56: Rat guards need to be at least one meter off the ground, or rats can jump over them. The vertical slat sides on this crib allow easy removal of grain.

Fig. 57: This metal silo was heating and cooling daily as it sat out in the sun, so the owners improved it by adding a thatch roof shade, or cover.

Fig. 58: These silos were imported as a development project. It was soon found that farmers could not afford them, that they heated and cooled rapidly, causing condensation and that they rusted through in three or four years.

Descriptions of the Dryers and Stores

Fig. 59: Good, wide, roof overhangs, raised high, rat guards and lots of ventilation. A crib this wide could be used to store maize only it it were field-dried or air-dried down to 13% moisture or less.

Food Drying Considerations

A. Enclosed Solar Dryers

1. The air flow must be high enough to remove moisture from the food.

2. Air flow is proportional to vent size and dryer height (chimney height is the distance from the top of the inlet vent to the bottom of the outlet vent), but inversely proportional to temperature within the dryer.

3. Tray depths should range from 1cm for small grains and legumes to 15cm for maize still on the cob.

4. A large outlet vent can be partially closed on partly sunny days to increase dryer temperature and opened on sunny days to maximize air flow.

5. Air flow rate should be between 1/3 and 1/2 cubic meters per minute per cubic meter of dryer volume.

6. The temperature must be high enough to remove moisture from the food without cooking the food. Temperature is proportional to collector area and insulation rate, but inversely proportional to vent size and chimney height and also inversely propotional to drying time.

7. Orient and tilt the collector to optimize solar collection on either a daily or annual basis.

8. A 3/4 square meter collector will remove 1 kilogram of water in a day. This will dry 1.5kg of fresh fruit or 5.25kg of grain per day.

9. A back-up heating system may need to be designed into the dryer to optimize drying and reduce spoilage of partially dried foods.

Food Drying Considerations

B. All Dryers

1. Humidity of the air must be low enough to remove moisture from the food. But even 80% humidity air will dry rice down to 18% moisture.

2. The dryer should keep out rain, dirt, insects, animals and sometimes people.

3. The dryer should be large enough to accomodate the crops to be dried at a given time of year, but small enough to be affordable.

Food Storage Considerations

1. Most dried foods should be stored in small, airtight containers in cool, dark and dry places. The containers should keep out moisture, insects, rodents and dirt. Small containers, like plastic bags, can be placed inside each other, larger containers such as jars or crocks, which can then be sealed for long-term storage. Gourds, such as calabashes, can be filled with dried foods, covered with cloth, tied tight with string and then dipped in hot wax to seal.

   Containers should be checked often. Moist, spoiled, or insect-infested small containers should be removed from the large container to reduce further contamination.

2. Some special storage considerations:

   A. Maize can be stored in cribs or other outdoor containers. It can be stored on the cob, once properly dried and pastuerized. Protect from rodents with screening. Allow cobs to be well-ventilated.

      Maize husks can be tied or woven together and draped over wires. Protect the maize from rodents by placing rodent guards at the ends of the wires.

      Maize can also be shelled (de-cobbed) and placed into bags and then into crocks, jars or tins.

   B. Sorghum, wheat and other grains should be pastuerized before storage. Store as you would maize. Pastuerization destroys viability of seed, however.

   C. Grain legumes can be stored with smaller grains which take up the inter-granular spaces and thus restrict movements of bugs and beetles.

      Grain legumes treated with lemon, groundnut, castor, coconut and mustard oils have been kept from insect attack for up to 6 months.

      Malathion treatment is effective on stored grains and grain legumes to kill insect eggs and larvae laid in the field.

Food Storage Considerations

D. Rice panicles can be stored much like maize (in a crib, as above).

Rice stored in the husk (as paddy) is more insect resistant than milled grain.

Rice stored at 30°C and 85% moisture will absorb moisture during the day and that moisture will condense at night, wetting the grain. Ventilated grain will not allow moisture to condense. Aeration also reduces the temperature due to evaporation.

E. Roots and tubers can be "cured" by being kept at high (35-40°C) temperature and relative humidity (85%) for a few days prior to storage. Curing promotes suberization and creates a callus over damaged areas.

Smoke Test Data Collection Sheet

Test Number	Color of Chimney (A)	Tilt (degrees) (B)	Orientation (N,W,E,S) (C)	Radius of Chimney (cm) (D)	Area of Vent (cm^2) (E)	Height of Chimney (m) (F)	Volume of Chimney (m^3) (G)	Time (sec) (H)	Air Flow (m^3/min) (I)	Inlet Air Temperature (^oC) (J)	Outlet Air Temperature (^oC) (K)
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											

Notes:

A. Color of chimney can be black, white, galvanized, etc.

B. Tilt of chimney is measured in degrees from the horizontal. Horizontal = 0^o Vertical = 90^o.

Smoke Test Data Collection Sheet

C. Orientation is determined with a direction compass. (N, E, S, W)

D. Radius equals one-half the diameter.

E. Area of Vent, is pi (π) times the square of the radius of the chimney or $A = \pi r^2$ where:
A=area, given in square centimeters, (cm^2)
π =pi=3.14159, or approximately 3
r=radius of chimney, (column D).

F. Height is <u>vertical</u> height, measured in meters, between inlet and outlet vents.

G. Volume, given in cubic meters=10,000 x A x h (or, V=kAh) where:
V=the volume, given in cubic meters (m^3)
k=conversion factor = 1 = 10,000 cubic centimeters per cubic meter ($10,000 cm^3/m^3$)
A=area of vent, given in square centimeters (cm^2), Column E
h=height of the chimney, given in meters (m), (column F).

H. Time is amount of time (seconds) elapsed between smoke being introduced into the inlet vent and smoke first appearing at the outlet vent.

I. Air Flow is given in cubic meters per minute (m^3/min) and equals column G - (column H x 60 seconds per minute).

J. Inlet Air Temperature is measured at the inlet vent of the chimney, is given in ^oC, and usually equals the ambient air temperature.

K. Outlet Air Temperature is measured at the outlet vent and given in ^oC.

Effective Group Survey

Group leaders, group facilitators and group members may sometimes want to assess the group's capability for working productively. This survey can be used by one or many, with the results posted and discussed toward the end of a meeting.

Directions: Circle the letter opposite each item on the survey below the best describes the group's interactions.

The scale used is:

A - All group members
B - Most group members (two-thirds or more)
C - About half the group members
D - A few group members (one third or less)
E - None of this group

During this (or the most recent) session, how many group members, including yourself:

1.	Gave due consideration to all seriously intended contributions of other group members?	A	B	C	D	E
2.	Checked (by paraphrasing, etc.) to make sure they knew what was really meant before agreeing or disagreeing?	A	B	C	D	E
3.	Spoke only for themselves and let others speak for themselves?	A	B	C	D	E
4.	Viewed all contributions as belonging to the group, to be used or not as the group decided?	A	B	C	D	E
5.	Had the opportunity to participate in the group if they desired to do so?	A	B	C	D	E
6.	Tried to find the reason if the group was having trouble getting work done?	A	B	C	D	E
7.	Helped the group make decisions openly rather than by default?	A	B	C	D	E
8.	Helped bring conflict into the open so the group could deal with it?	A	B	C	D	E
9.	Looked upon behavior which hindered group process as a group problem, rather than as a "problem member"?	A	B	C	D	E

Reprinted from Systematic & Objective Analysis of Instruction Training Manual. Portland, OR: Northwest Regional Educational Laboratory, 1970.

The Decision-Making Process

The following types of decision making are familiar to all of us:

1. Plops
   A decision suggested by an individual to which there is no response (e.g., "I suggest we shelve this question.")

2. Self-Authorization
   A decision made by an individual who assumes authority (e.g., "I think we should all write our ideas on the blackboard." -- and proceeds to be the first to do so).

3. The Handclasp
   A decision made by two or more members of the group who join forces or decide the issue in advance (e.g., "That was a helpful comment, John. Yes, that's the course we're going to take.")

4. Baiting
   A decision made by pressure not to disagree (e.g., "No one objects, do they?"), or a decision made by pressure to agree (e.g., "We all agree, don't we?).

5. Majority Rule
   A decision made by some form of voting.

6. Unanimity
   A decision made by overt and unanimous consent, often without discussion.

7. Polling
   A decision made by a form of voting which inquires, "Let's see where everyone stands." -- and then proceeds to tabulate the already expressed majority decision.

8. Consensus
   A decision made after allowing all aspects of the issue, both positive and negative, to be put forth to the degree that everyone openly agrees it is probably trhe best decision. This is not necessarily unanimity, but it constitutes a basic agreement by all group members.

Feedback and the Helping Relationship*

Some criteria for useful feedback:

1. It is descriptive rather than evaluative. By describing one's own reaction, it leaves the individual free to use it or not to use it as he/she sees fit. By avoiding evaluative language, it reduces the need for the individual to react defensively.

2. It is specific rather than general. To be told that one is "dominating" will probably not be as useful as to be told the "just now when we were discussing the issue you didn't listen to what others said and I felt forced to accept your arguments or face an attack from you."

3. It takes into account the needs of both the receiver and the giver of feedback. Feedback can be destructive when it serves only our own needs and fails to consider the needs of the person on the receiving end.

4. It is directed toward behavior which the receiver can do something about. Frustration is only increased when a person is reminded of some shortcoming over which he has no control.

5. It is solicitied, rather than imposed. Feedback is most useful when the receiver him/herself has formulated the kind of question which those observing him/her can answer.

6. It is well-timed. In general, feedback is most useful at the earliest opportunity after the given behavior (depending, of course, on the person's readiness to hear it, support available from others, etc.).

7. It is checked to insure clear communication. One way of doing this is to have the receiver try to rephrase the feedback he/she has received to see if it corresponds to what the sender had in mind.

8. When feedback is given in a group, both giver and reciever have opportunity to check with others in the group the accuracy of the feedback. Is this one person's impression or an impression shared by others?

Feedback, then, is a way of giving help; it is a corrective mechanism for the individual who want to learn how well his/her behavior matches the intention and it is a means for establishing one's identify -- for answering "who am I?"

* Taken from the Reading Book: Laboratories in Human Relations Training, Washington, D.C.: NTL Institute for Applied Behavior Science, associated with the National Education, 1969.

NON-FORMAL ADULT EDUCATION

(Adapted from Perspectives on Non formal Adult Learning by Lyra Srinivasan)

The demands of a developing world have in the past thirty years given us a new appreciation of nonformal ways of providing education for adults who either have not had access to formal schooling or whose formal education has proved inadequate or irrelevant. In some areas of the world, where a new push toward development demanded the participation of millions of uneducated adults, the existing formal institutions were incapable of undertaking a task of such magnitude. In other areas, large sections of the population found that the formal systems had not given them the skills they needed to compete successfully in technological societies.

The ideas of two educators, Ivan Illich and Paulo Freire, have been among the most influential in this new field of non formal education

THE CALL FOR SOCIAL REFORM: ILLICH AND FREIRE

Ivan Illich and Paulo Freire attack traditional styles of education from different angles, but they both start from a concern for the dignity and worth of the individual and for the liberation of men and women from an oppressive or exploitative environment.

Illich calls for a cultural revolution, believing strongly that the mere revision of the formal school system will not result in the regeneration of society he seeks. In fact, at the root of the problem are the exaggerated importance attached to credits and certification, the educational monopoly claimed by schools, the tendency to "confuse teaching with learning, grade advancement with education, a diploma with competence, and fluency with the ability to say something new".

The value that Illich attaches to creativity as an attribute of a freely growing, fully expressive society, makes him particularly critical of the traditional role of the teacher. In this, he is close to Freire (although Freire launches his attack on traditional schooling from a more political standpoint, speaking in terms of the "oppressor" and the "oppressed").

Both reformers contend that the teacher-dominated system of education robs the learner of his self respect. The way in which the teacher deals with his pupil cancels the safeguards of individual freedom, claims Illich. "When the schoolteacher fuses in his person the functions of judge, ideologue, and doctor, the fundamental style of society is perverted by the very process which should prepare for life. A teacher who combines these three powers contributes to the warping of the child much more than the laws which establish his legal or economic minority, or restrict his right to free assembly or abode".

What gives the schoolteacher such power over his learners? A false assumption, Illich believes: the assumption that there is a secret to everything in life, that the quality of life depends on knowing that secret, that secrets should be revealed only in orderly succession, and that only teachers can properly reveal these secretes.

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At least half of the world's people never set foot in school and perhaps have no direct contact with teachers. Yet, Illich points out, adult illiterates learn quite effectively the demeaning message that our educational systems teach: that in order to amount to something, people must depend on schools to unlock all doors. Furthermore, the schools reinforce the adult illiterates' sense of inferiority by demanding that they provide for schools through taxes, while the bureaucracies of the educational systems raise their expectations for what those schools can provide and their children are taught to confirm the demagogues' claims

Accordingly Illich advocates as a solution the "inverse of school," where the learner will establish new relationships with his environment and choose what and from whom he wants to learn. This, he believes, would undo the monopoly that teachers generally enjoy as the sole legitimate dispensers of "right" education.

Traveling a different route, Freire comes to a similar conclusion: learners need to be liberated from the oppression of the traditional teacher. But Freire's solution is to evolve a style of teaching which, in itself, is intrinsically liberating.

Through education, adult illiterates must arrive at a new awareness of their own selfhood and start to look critically at their own social situation in order to take steps to change the society that has previously denied them an opportunity to participate. Thus, for Freire, education in its true sense is, and should be, a revolutionary force.

But if it is to serve the purposes of social revolution, education must first be capable of helping man become more aware of, and responsible for, himself and his world through a process of reflection followed by action and further reflection. This, he calls praxis.

Unlike Illich, Freire does not blame social atrophy primarily on the school system. Freire traces the root causes of apathy and ignorance to class oppression and to what he sees as the mistaken paternalism of society as a whole. The class structure of present-day society, he claims, does not encourage or equip the poor to know and respond to the concrete realities of their world. Rather, the oppressed are kept locked into a situation where the development of their own critical awareness and response is practically impossible. This he calls the "culture of silence" of the dispossessed.

Thus the school, though not entirely to blame, is viewed by Freire as a major instrument in maintaining that culture of silence, because it fails to encourage critical analysis of reality, egalitarian dialogue, and the mutual humanization of teachers and learners.

Freire main contribution to the field lies in the concept of conscientizacao, which has been translated as "conscientization" - a word coined to describe the arousing of man's positive self concept in relation to his environment and society through a "liberating education" which treats learners as subjects (active agents) and not as objects (passive recipients). A liberating education must accordingly shed the elements that perpetuate the dichotomy of one set of people in positions of prestige and authority, the oppressors, and the other in positions of dependence and inferiority, the oppressed.

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To help the peasant break away from traditional fatalism and feelings of powerlessness. Freire emphasizes reflective thinking as the crux of the educational program. He then introduces the concept of praxis (reflection/action/reflection) as man's real function: men and women are not objects to be manipulated but are active, creative subjects with the capacity to examine critically, interact with, and transform their worlds.

Since teaching style seems to be a key factor in this process, Freire offers a detailed analysis of the shortcomings of the prescriptive style of teaching. This is perhaps his most direct and practical contribution to nonformal education ideology.

In prescriptive or directive teaching, the teacher assumes an authoritarian role as the one best qualified to prescribe what the learner should learn and how he should think and behave. The teacher acts as the guardian of the secret, as Illich describes it. This authoritarian role tends to diminish the learner as a human being. Thus Freire claims that "every prescription represents the imposition of one man's choice upon another, transforming the consciousness of the man prescribed to into one that conforms with the prescriber's consciousness."

Freire is unsparing in his attack on this prescriptive kind of teaching, which he refers to as the "banking system". His criticism has found a good measure of support among nonformal educators around the world.

In the banking system of education, the main transaction, according to Freire, is the act of transferring information form the teacher's head and depositing it in the students' heads. The students are thus the depositories and the teacher is the depositor. Certain traditional teaching attitudes and practices are logically deduced from this premise.

Freire describes them as a system of domestication which reflects the oppressive nature of society as a whole:

1- the teacher teaches and the students are taught;
2- the teacher knows everything and the students know nothing;
3- the teacher talks and the students listen-meekly;
4- the teacher disciplines and the students are disciplined;
5- the teacher chooses and enforces his choice, and the students comply;
6- the teacher acts and the students have the illusion of acting through the action of the teacher;
7- the teacher chooses the program content, and the students (who were not consulted) adapt to it;

In opposition to this "domesticating" system. Freire suggests a problem-posing education which breaks the vertical patterns characteristic of traditional teacher/student relations and establishes horizontal dialogue. Thus, in Freire's conscientização:

- no one can teach anyone else;
- no one learns alone;
- people learn together, acting in and on their world".

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There is no longer an authority-dependency relationship. Instead of domesticating, the learning experience provides adults with opportunities for critical analysis of their environment, for deepening their self-perceptions in relation to it, and for building confidence in their own creativity and capabilities for action. It has been observed that even literacy when approached from Freire's standpoint is transformed from a mere technical skill into a component of a process that implies values, develops mentalities, and leads to social and political consequences.

Teachers and students thus become jointly responsible for a process in which all grow. The philosophical assumption is that men and women as conscious beings are capable of reflection on and critical intervention in reality. Education must therefore increasingly challenge them, move them to authentic and critical reflection, thereby increasing the scope of their perception, and evoking new challenges and commitment to their spontaneous action upon reality. This whole process is described by Freire as one of humanization - the pursuit of full humanity - which he identifies as man's historical vocation.

Although many educators do not agree with Freire's socio-political orientation, his ideas on conscientization and problem-posing education have profoundly affected the concepts underlying a number of nonformal education programs.

What have been most borrowed or adapted are some of Freire's techniques for establishing dialogue and engaging the learner in praxis (reflection/action/reflection).

SOME ASSUMPTIONS IN NONFORMAL EDUCATION

Today's educators must become more conscious of the unique opportunities which this field offers us-to be inventive, to experiment, to examine, to learn, to perfect new techniques and refine concepts. The field is still wide open, with no prescriptions and no right-for-all-times answers. In planning new strategies best suited to the needs of particular learners in particular settings, we are as free to draw inspiration from science as from the arts, from business management and social services, from modern practical invention as well as from ancient philosophies. Openness to experimentation characterizes nonformal education at this stage of its development and provides one of its special challenges.

The eight assumptions listed below are not all equally relevant to all innovative nonformal education projects, nor equally shared by all practitioners in the field. But we believe they are consistent with the basic philosophy that underlies non formal education practices.

1. Adults in rural areas are more likely to accept new ideas when they can understand them in the context of their priorities and interrelated with the other important segments of their lives.

2. Effective learning takes place most easily when there is strong motivation to learn. The motive power needs to come from inner convictions and not from mere persuasion or external incentive.

3. The individual's capacity to contribute to development requires that he/she be able to clarify value positions, discern cause-effect relationships, make considered judgment and take responsibility for action. Learning experiences can be structured specifically to promote these attitudes, abilities and behavior.

4. The learning experience should further enable the learner to change the way he uses himself (e.g., from passive to active, timid to confident, routine to creative). This is a fundamental growth objective.

5. Conscientization is not something that can be "done" to people - it must spring from within. However, self-concepts can be strengthened and expanded through sensitive preparation of the learning experience and environment.

6. In rural development the people are often their own major resource. At every stage of the educational process, local leaders and learning group peers-who can play an important role in reinforcing and legitimizing change- should be trained and involved in a variety of leadership roles in support of the program. Further, a facilitator drawn from within the community or from a comparable setting will be at least as successful as an outsider, if not more so. The facilitator can help create the climate of trust which is the first step in fostering human development. The selection, training, and use of facilitators is therefore of vital importance.

7. Learning materials can be developed locally with the full creative involvement of learners and can greatly increase the relevance and impact of training programs.

8. Training as well as field operations must be carefully documented, analysed and evaluated. The experience must then be ploughed back into program planning and further training so that future programs can benefit from our experience today.

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EXTENSION, TRAINING AND DIALOGUE: A NEW APPROACH FOR TANZANIA

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Extension, Education and Development

Training and extension work with farmers is both an educational effort and a means of development and a part of that development. Before we can begin to criticize traditional training and extension techniques and advocating new ones, it is important to be clear what we mean by development and how training and extension work relate to this goal. Until recently, development was usually defined in economic terms such as changes in the Gross National Product, per capita and economic living standards. Training, and especially agricultural extension, were viewed as an economic development tool; as an investment in human capital on which a return was expected. This implied a directly functional approach to teaching and learning which was focused on "practical" skills and immediate pay-offs.

This view has changed over the past ten years due to concerns about income distribution, dependency on government and other social and political concerns. Now almost every statement about training and development mentions the importance of participation, mobilization, equality and self-determination. Since independence, the party and the Tanzanian government have defined development as liberation. Development is:

> A permanent revolution for the total liberation of the people of Tanzania and Africa from all forms and manifestations of domination, exploitation, oppression, humiliation, weakness, racism, poverty, ignorance, disease and misery (Daily News, 1975)

> For development has a purpose: that purpose is the liberation of man. It is true that in the Third World we talk a great deal about economic development -- but the goods are needed to serve man; services are required to make the lives of men more easeful as well as more fruitful. Political, social and economic organization is needed to enlarge the freedom and dignity of men; always we come back to man -- to liberated man -- as the purpose of the development activity. (Nyerere, 1976)

Development is thus more than a change in material welfare, farming practices or yield per hectare or return per man-day of labor. Development involves changing people, changing their

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consciousness or awareness and helping them to become "beings for themselves" -- making their own political, cultural and economic decisions. "The expansion of (man's) own consciousness, and therefore power over himself, his environment and his society, must therefore ultimately be what we mean by development." (Nyerere, 1976)

Education is thus both an end and a means of development. Development which depends on the actions of men requires a change in their consciousness, so that they are the determinant of their own actions. Farmers follow a given practice not because of traditionalism, but because they see it as the best method in the face of their own particular situation. To change these practices either demands force or a change in awareness which convinces them that a different form of action better meets their needs.

Raising the farmers' awareness is the role of both training and extension work. "Adult education has to be directed at helping men and women to develop themselves -- to think clearly -- to examine possible alternative courses of action; to make a choice between those alternatives in keeping with their own purposes; and to equip them with the ability to translate their decisions into reality." (Nyerere, 1976) The "developed" farmer is not the one who is "progressive" or follows the recommended practices (although he or she may do this); rather the developed farmer is the one who is critically aware of his or her situation and acts on it in accordance with this awareness.

The Traditional Approach

Education and extension in Tanzania and other developing countries have received a great deal of criticism. While in part this is unfair because of unrealistic expectations and a failure to see training and extension in the context of other factors influencing development work, much of the criticism is deserved. Part of the blame can be put on the traditional training and extension approaches used in the villages and elsewhere. This approach has variously been called the banking, empty cup, directive or top-down approach. Its essence is that the trainer or extension worker is the expert who knows (full cup) and tries to give (deposit as in the bank) this knowledge to the farmer or villager (empty cup) whose role is to passively receive and acknowledge what was received from the expert.

The assumption underlying this relationship is that the trainer or agent knows what is good for the farmer or village. Thus, the relationship is vertical and assumes a one-way flow of information from the top down. The farmer or villager is seen as ignorant, lacking knowledge, traditional and resistant to change. This means he or she is helpless and must be helped to develop, almost in spite of themselves. The farmer or villager is the passive learner, while the trainer or extension agent is the active educator.

In practice what this boils down to is that the trainer or agent, whether at a meeting, demonstration program or training session, is always in the position of telling villagers what to do. He tries to provide them with solutions to their problems much in the same manner a doctor provides prescriptions to medical problems. In a village one may find a list of the "ten commandments" of good farming posted. In a meeting one will hear the Katibu Kata exhort farmers to weed properly and the Bwan Shamba telling them that eight sprayings of insecticide are necessary to produce good cotton. Farmers rarely raise objections, because they know that such objections are not welcome and often accept the role of the ignorant, passive listener because they are continually told they are. They therefore exist in an oppressive environment over which they exercise little control. If they do object, they are quickly silenced by references to "wataalamu" research and "modern methods" (meaning they are ignorant and traditionalistic) or they need to work (meaning they are lazy). Rather than objecting openly and thus offering to educate the trainers or extension workers and be educated in return, most farmers remain silent. They go home and fail to put into practice what was suggested, even when they may have agreed to do so in the meeting.

The failure of farmers to follow the expert's advice is discouraging to the expert and reinforces the feeling that farmers irrationally resist change. As a result, educators and extension workers tend to work with those few who seem more open to their suggestions -- the "progressive" farmers -- and to advocate the use of pressure to force farmers to use recommended practices for their own good. As one RADO told me, "A farmer who refuses to follow recommended practices is like a sick man: you have to force him to eat and he will thank you for it when he becomes better."

Failure of the Top Down Approach

Unfortunately the farmer often does not become "better" in the sense that he or she obtains a significant benefit from the forced practice. This reveals one of the fallacies underlying the traditional approach: the assumption that all recommended practices are good and that the experts are always right. Experience and research in Tanzania have shown that many practices either recommended to the farmers or forced on them did not benefit the farmers and their rejection of them was quite rational.

Some recent examples are:

1. The use of fertilizer on maize in the lower altitude areas of Morogoro, Tanga and Iringa Region.

2. Growing maize and many other crops in monoculture.

3. Early planting and close spacing of cotton.

4. Production of cotton in many areas of the "Eastern Zone."

Thus, while many recommendations are good, experience has shown that when evaluated from the farmer's perspective, many do not solve the farmer's most pressing needs and are, therefore, unacceptable.

This brings up the second fallacy of the top-down approach: the assumption that farmers and villagers are ignorant. It is true that many of them have little formal education and are illiterate. It is not true that they have learned nothing and know nothing. (It is unfortunate that in Swahili, the same word, ujinga, can be used for both illiterate and ignorant, because the two cannot be equated.) Farmers, through experience and the informal sharing of ideas, have developed a wealth of knowledge about agricultural production and survival in an often harsh environment. They also have a better understanding of their problems, needs, priorities, resources, values, attitudes, local culture, etc. Educators and extension agents tend to be outsiders and members of a different socio-economic class.

Thus, both the extension agent or trainer and the farmer or villager have some knowledge necessary to bring about changes in practices. The scientific knowledge of the researcher needs to be complimented by the more natural knowledge of the farmer to bring about a critical understanding of the problem and the basis for action.

The third major fallacy of the top-down approach is the assumption that knowledge can be given or extended by the trainer and extension agent. Knowledge cannot be poured into the adult learner like tea into a cup. Informed action develops in learners as a result of interaction with information, the situation and fellow human beings. Learning is not an activity of the trainer, but of the learner, and involves a change from one way of understanding or doing something to another. Adults in particular have developed attitudes and ways of doing things. Learning often involves the rejection of existing ideas and acceptance of new ones.

This leads to the importance of understanding the farmer's present knowledge and understanding and these must form the foundation of any new learning. Only an active interaction with ideas and other people can result in the learner really understanding new ideas and making them his or her own, instead of them merely being someone else's ideas.

Finally, another major criticism of the top-down approach, particularly important in the Tanzanian context, is that it builds a dependency relationship between experts (often seen as representing government) and farmers and villagers. It means

presenting the farmers with solutions to their problems, defined in the first place by the experts, instead of analyzing their problems with them, in order to fully understand them, and coming to a solution cooperatively. The traditional approach makes the farmer feel dependent on the continued advice of the trainer or extension agent, as it fails to teach him how to analyze and solve problems on his own. While the government and the party have accepted liberation as the major goal of development, the top-down approach to adult education and extension work encourages dependency and passivity.

Instead of seeing men and women as the end of development, it treats them as a means, tools to be manipulated as efficiently as possible in order to achieve the goals of those in power. In the face of the above, it seems fair to conclude that the present, prevailing approaches to adult education and extension work are not only ineffective but actually are detrimental to the development of Tanzanian farmers and villagers.

The Dialogue Approach

The dialogue approach, illustrated in Table 1, is the opposite of the traditional, top-down approach. Its essence is the horizontal sharing of ideas between trainers/learners, learners/trainers in a process of reflecting and acting on the world in order to understand it and control it better. It is based on faith in people, in his or her ability in cooperation with others, to be able to understand self and situation, and to act on it and change it.

The dialogue approach assumes that both the trainer or extension agent and the student or farmer know something about the subject of interest, especially if the goal is for the learner to apply what is to be learned. Although one may have more general or abstract knowledge and the other may have more informal and specific knowledge, this difference does not make one or the other superior in the situation. It is the shared knowledge both have in the situation which is superior. Within the constraints of each party's environment, each can learn and change as a result of interacting with each other.

While all farmers have some knowledge, they are not always aware of this knowledge. In fact, because they are constantly told that they are backward, lazy, ignorant and thereby made to accept that they are "hopeless," they often feel that they know nothing. When farmers can be drawn out in dialogue as a group, they are often surprised at how much they already know, collectively, about a wide range of production or development problems. It is important, in the beginning, to draw out what the farmers or villagers already know to be able to build on it. As Mwalimu Nyerere points out, by drawing out what the farmers know (which can only be done through dialogue) and showing the relevance of

what is known to what is being learned, the trainer achieves three things:

> He has built up the self-confidence of the man who wants to learn, by showing him that he is capable of contributing. He has demonstrated the relevance of experience and observation as a method of learning to be combined with thought and analysis. He has shown what I call the "maturity" of learning -- that is, by sharing our knowledge, we extend the totality of our understanding and our control over our own lives.

The trainer's role in dialogue is not to present knowledge to the learner but to lead the learner to an examination of problems --to ask the learner to critically reflect and act on problems (problem-posing). Knowledge or learning grow out of this reflection-action cycle. The farmer will never learn the benefit of a practice and the problems associated with it until he has actually tried it and then thought about his experience critically.

Traditional Approach	Dialogue Approach
1. Educators teach and farmers are taught.	1. Educators and farmers are both involved in learning.
2. Experts know everything and the farmers know nothing.	2. Both have knowledge to contribute to joint learning.
3. Educators possess the authority of knowledge and have a monopoly on it -- which they perpetuate.	3. Knowledge is the property of everyone. No one can or should monopolize it.
4. Educators/experts think and farmers are thought about.	4. Farmers are encouraged to think on their own.
5. Educators/experts are active and farmers are passive during learning.	5. Both educators and farmers are active during learning.

Table 1

Neither will the trainer or extension agent know the value of his ideas until he has shared them with the learner and tested them out against the farmer's perceptions and experience. Dialogue thus requires both action and reflection, experience and thought. Without action, teaching is merely verbalism and amounts

to exhorting the farmers to do this or that without showing them how to do it and thus has limited impact on their farming practices. Without reflection, extension work can become mindless activism in which farmers are forced to follow certain practices without understanding them and without the farmers themselves being developed.

Is Dialogue Feasible ?

Let us examine two objections to the use of the dialogue approach often made by extension agents, educators and government officials.

1. The first is that it is impossible to dialogue with farmers or villagers because they know little or nothing about modern agriculture or how to make a village cooperative work.

2. The second objection is that it is too slow and expensive, that our problems need urgent solutions and therefore cannot wait for a long process of dialogue to take place.

Materials and Tools List

Materials	Item, size	Unit Cost
Mudblocks		
Cement, 50kg bag		
Sand		
Gravel		
Clay		
Chicken wire		
Plastic Sheet		
Window screen		
Mosquito Netting		
Wire, thin		
Twine, 2-3mm		
Bush Rope		
Nails:	3cm	
	5cm	
	8cm	
Paint, black		
Paint, white		
Corrugated metal roofing		
Corrugated Fiberglass roofing		
Lumber:	1" x 6"	
	2" x 2"	
Large baskets		
Woven mats		
Bush poles		
Bamboo poles		
Reeds		
Calabashes		
Large Tins		
Salt		
1% Malathion Dust		

Tools

Shovel
Saw
Hammer
Pliers
Tin Snips
Trowel
Paint Brush
Bucket
Wood chisel
Tape measure
File
Thermometers
Paring Knives
Bubble Level

Guidelines for Process Observer

This handout should be used to process Session 12, Facilitation Skills. It is, however, general enough so that it can be used (along with the list of facilitation skills developed in Session 12) to evaluate any meeting, group activity, session or program.

Instructions: Answer the following questions and give two or three specific examples to back up your responses.

I. The Activity

A. Did the group meet the objectives of the activity?

B. What is your opinion of the information generated?

C. What points (if any) are missing from the information?

II. The Process

A. What went well?

B. What could have gone better?

C. Was the activity clear?

D. What was the decision-making process of the group?

E. Did everyone agree on the decisions made?

F. Was there active participation by all?

G. Was there a relationship between the amount of participation and factors such as sex, age, nationality or job position?

H. Did the group utilize all of the resources available to it?

I. How did the activity measure up to the list of facilitation skills?

Guidelines for Process Observer

III. The Roles

A. The Facilitator

1. Did the facilitator demonstrate effective facilitation skills (according to the list developed by the group)?
2. What was the style of the facilitator?

B. Did the recorder fulfill the role?

C. Did the timekeeper fulfill the role?

Tests for Dryness

Often, the cause of spoilage in stored, dried foods (grains, legumes, fruits and vegetables) is improper or insufficient drying prior to storage. The following tips will help you to determine dryness and prepare foods for storage.

People often have their own tests for dryness which have probably been historically accurate for local foods and local storage techniques. If there are no local tests, the following can be used:

Grains (such as maize, rice, etc.): Fresh food moisture content: 25-35%. Dried food moisture content: 12-15%. Food, when dry, will appear brittle, glassy, semi-transparent. Will crack when hit with a hard object. When shaken in a jar with dry salt, will not cause the salt to clump.

Legumes (such as beans, peas, etc.): Fresh food moisture content: 30-40%. Dried food moisture content: 18%. When dry, is hard, brittle, cracks clean when broken, rattles when stirred or shaken. Slightly smaller than fresh.

Vegetables (such as yams, cabbage, etc.): Fresh food moisture content: 70-85%. Dried food moisture content: 18%. Dry food is tough to brittle while retaining natural color. Root vegetables are leathery when dry.

Fruits (such as bananas, papaya, etc.): Fresh fruit moisture content: 70-85%. Dry fruit moisture content: 10-14%. Dried fruit is leathery, pliable, tough, slightly darkened. Will fall apart after squeezing together.

Percent Moistures for Grains and Legumes

1. This handout lists percent moisture (P.M.) levels for beans, groundnuts, rice, maize, sorghum, barley, wheat and rye.
2. If the percent moisture (P.M.) is given as a range, it is listed here at the lower end of the range.
3. The following percent moistures (P.M.s) are listed:
   a. maximum allowable P.M. for harvest
   b. usual P.M. at harvest
   c. P.M. for one year safe storage
   d. equilibrium moisture content (E.M.C.) for dry season conditions (60% Relative Humidity - R.H.)
   e. E.M.C. for wet season conditions (80% R. H.)
   f. growing conditions for molds and bacteria

Percent Moisture	Condition
40%	
38	maximum harvest of wheat
35-36	maximum harvest of maize, sorghum
35	maximum harvest of groundnuts at lifting without curing
32	maximum harvest of oats
30%	
30-40	maximum harvest of beans
30	maximum harvest of barley, rice
25	maximum harvest of rye
23-26	good growing conditions for many bacteria, yeasts and fungi
20%	
20-23	good growing conditions for Aspergillus, penicillum and yeast
18-20	optimal harvest of barley, wheat
17-18	EMC of beans and rice at 25°C and 80% R.H.
16-25	usual harvest of rice
16	EMC of shelled maize at 30°C and 80% R.H.
15	one year safe storage of oats
15	EMC of sorghum at 30°C and 80% R.H.
14-30	usual harvest of maize
13	point below which microorganisms cannot grow in grain
13	one year safe storage of barley, maize, rye, wheat
12-13	E.M.C. of beans and rice at 25°C and 60% R.H.
12-14	one year safe storage of rice, sorghum
12	E.M.C. of shelled maize and sorghum at 30°C and 60% R.H.
10%	
10-18	usual harvest of barley, oats, sorghum, rye
10	one year safe storage of groundnuts in pods
9	E.M.C. of shelled groundnuts at 21°C and 80% R.H.
9	grain too dry for insect growth
9-17	usual harvest of wheat
7	E.M.C. of shelled groundnuts at 21°C and 60% R.H.
6-8	grain overdried for germination

C	F
121°	250°
115°	240
110	230
104	220
99	210
93	200
88	190
82	180
77	170
71	160
66	150
60	140
54	130
49	120
43	110
38	100
32	90
27	80
21	70
16	60
10	50
4	40
-1°	30
-6	20
-12	10
-18	0°
-23	-10
-29	-20

HANDOUT 13C

Summary of Temperature Factors

Blanch or steam at 100°C for 20 minutes to sterilize.

Pastuerize at 80°C for 10-15 minutes

75°C maximum drying temperature for livestock feed

60°C maximum drying temperature for human food (except rice and beans) maximum temperature for milling into flour

Pasteurize at 57°C for one hour

45-60°C is a good range for drying foods quickly without severe loss of nutrients or color while protecting from microorganisms and enzyme action

45°C maximum temperature for brewery grain, seed grain and rice for food

35°C maximum temperature for beans for human food

Food can spoil on the drying racks below 40°C in a humid climate

Fish will cook in the 20-30°C range in direct sunlight

Dried meats and fish should be stored below 5°C to avoid rancidity

CONDITIONING AND PASTERUZIING

Conditioning

Each batch of food should reach a point of uniform dryness before being sorted. Conditioning equalizes the moisture content between under- and over-dried pieces within a batch.

To condition: Allow the food to cool. Place in a large (20-150 liter) open-top container. Do not use an aluminum container! Line the container with a layer of plastic (if available) and then a layer of cloth. Stir and inspect the food once or twice a day for one to two weeks. Remove overly moist pieces to avoid spoilage. Re-dry the entire batch if condensation appears on the inside of the container. Add newly dried food of the same type to the conditioning container for ONLY the first half of the conditioning process. Keep insects and animals out of the conditioning food. Keep container indoors in a well-ventilated area.

Pastuerizing

Most grains and some legumes will be harvested with insect eggs in or on the food itself. These eggs will not be destroyed during the drying process and will hatch after the food is put into storage. Therefore, it is necessary to pasteurize grains and some legumes and vegetables to kill insect eggs. Pastuerize by bringing the dried food to 80°C for 10-15 minutes, or 57°C for one hour. These temperatures will also destroy spoilage agents such as fungi and bacteria. A heat source other than the sun may be needed for these high temperatures.

Note: Pastuerizing will severly reduce the viability of grain and legume seeds (see Handout 13C for maximum temperatures of grains and legumes).

Sample Cost - Benefit Analysis for a Solar Dryer

Steps for Determining Present Value of a Project

A. List all costs and benefits (labor, materials, maintenance).
B. Adjust costs and benefits involving foreign exchange upwards by the foreign exchange multiplier.
C. Add up total benefits (B) and total costs (C).
D. Use equation to calculate PV or Net PV.
E. Compare options and choose project with highest PV (for 1 year) or Net PV (over many years).

Costs:

Equipment: or materials (list total cost of the dryer):	$ 75.00
Labor (multiply number of workers times cost of labor times number of days)	25.00
Annual Maintenance (count all of the materials and labor costs to keep the dryer in working condition)	10.00
Total Costs:	$110.00

Benefits

Worth of drying one years crops	$ 35.00
Worth of status of owning dryer (50% of total cost)	55.00
Worth of using dryer in off-season for other uses	15.00
Worth of drying own, best seed, drying crop on time, not overdrying, loss of theft, etc.	25.00
Total Benefit:	$130.00

$$\text{Present value} = \frac{\text{Benefit - cost}}{1 + \text{interest rate}}$$

$$\text{Present value} = \frac{\$130 - \$110}{1 + 15\%} = \frac{\$20}{1.15} = \$17.39$$

Payback and Return on Investment

$$\text{Payback} = \frac{\text{Total Cost}}{\text{Present Value}} = \frac{\$110}{17.39} = 6.3 \text{ years}$$

$$\text{Return on Investment} = \frac{100\%}{\text{Payback}} = \frac{100\%}{6.3} = 18\%$$

This shows that at the current interest rates and values, the device will pay back in about six years (with an annual return-on-investment of about 18%, which is more than three times greater than a savings account at 5%). And after the six years, the benefits will remain even though the costs have been substantially reduced (down to maintenance costs only).

Lifecycle Unit Cost Analysis of a Solar Dryer

Some farmers may want to know, "How much will it cost to dry my crop using a solar dryer?", or, "What is the unit cost (cost per weight) of the product that can be processed by the dryer?" In order to find an approximate cost-per-unit weight over the lifetime of a solar dryer, you can use the following formula:

$$\text{Lifetime cost per unit weight} = \frac{T.L.C.}{L.D. \times A \times L \times W \times Y}$$

where:

TLC = Total Lifetime Cost = initial cost of the solar dryer plus the cost of repair and maintenance over the lifetime of the dryer, considering the inflation rate, plus the initial cost of the back-up heater plus the cost of back-up fuel over the lifetime of the dryer.

L.D. = Loading density of the dryer, given in weight per area of tray, such as kilograms per square meter.

A = Area of trays, given in the same units as L.D., i.e.,: square meters

L = Loads per week, using a conservative estimate of the number of times in a week that the dryer will be loaded with fresh food.

W = Number of weeks per year the dryer will be used, given in the conservative estimate of weeks per year that the dryer can possibly be used, depending on crops, harvest, weather, etc.

Y = Number of years the dryer will be functional before it needs a complete replacing.

Example: Find the unit cost for a solar corn dryer assuming the following conditions.

The dryer cost is \$100. The back-up heater cost is \$25. The cost of repair and maintenance is 1% per year with inflation at 15%. The cost of back-up fuel is \$50 for the life of the dryer (10 years). The loading density is 5 kg/m^2 and the area of the trays is 10 m^2. 1.5 loads can be put into the dryer each week and the system is usable 12 weeks out of the year.

Lifecycle Unit Cost Analysis of a Solar Dryer

The unit cost (given in $/kg) of the dried corn is:

$$\$/kg = \frac{\$100 + \$25 + \$50 + \$20}{5\ kg/m^2 \times 10\ m^2/load \times 1.5\ load/week \times 12\ weeks/yr \times 10\ years}$$

$$\$/kg = \frac{\$195}{9000\ kg}$$

$\$/kg = \$0.02/kg = 2¢$ per kilogram

The farmer can now compare this number to the cost per unit weight he or she is charged by someone else to have corn dried. If this cost is lower, then it makes economic sense for the farmer to invest in a solar dryer. If this cost is higher, then the solar dryer needs to be built for less cost in order to become competitive with the "conventional" type of drying.

Mid-Program Evaluation

Please rate your general satisfaction of the training program, to date:

1.	General Satisfaction	1	2	3	4	5
		Not Satisfied At All				Extremely Satisfied

2. Has the program met your expectations?

3. Is the technical level too high or too low?

4. Is the program providing adequate technical skills and extension training?

5. Could the program be better adapted to suit individual needs? How?

6. What has gone well over the past week?

7. What hasn't gone well over the past week that could be improved in the upcoming week?

Economic Comparison of Two Maize Stores

Fig. 1

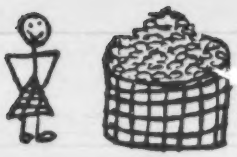


Fig. 1

Fig. 2

Fig. 2

Fig. 3

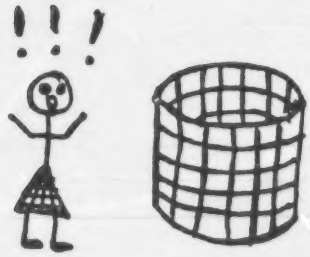


Fig. 3

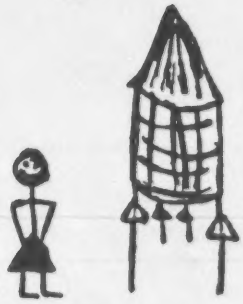


Fig. 4

Fig. 4

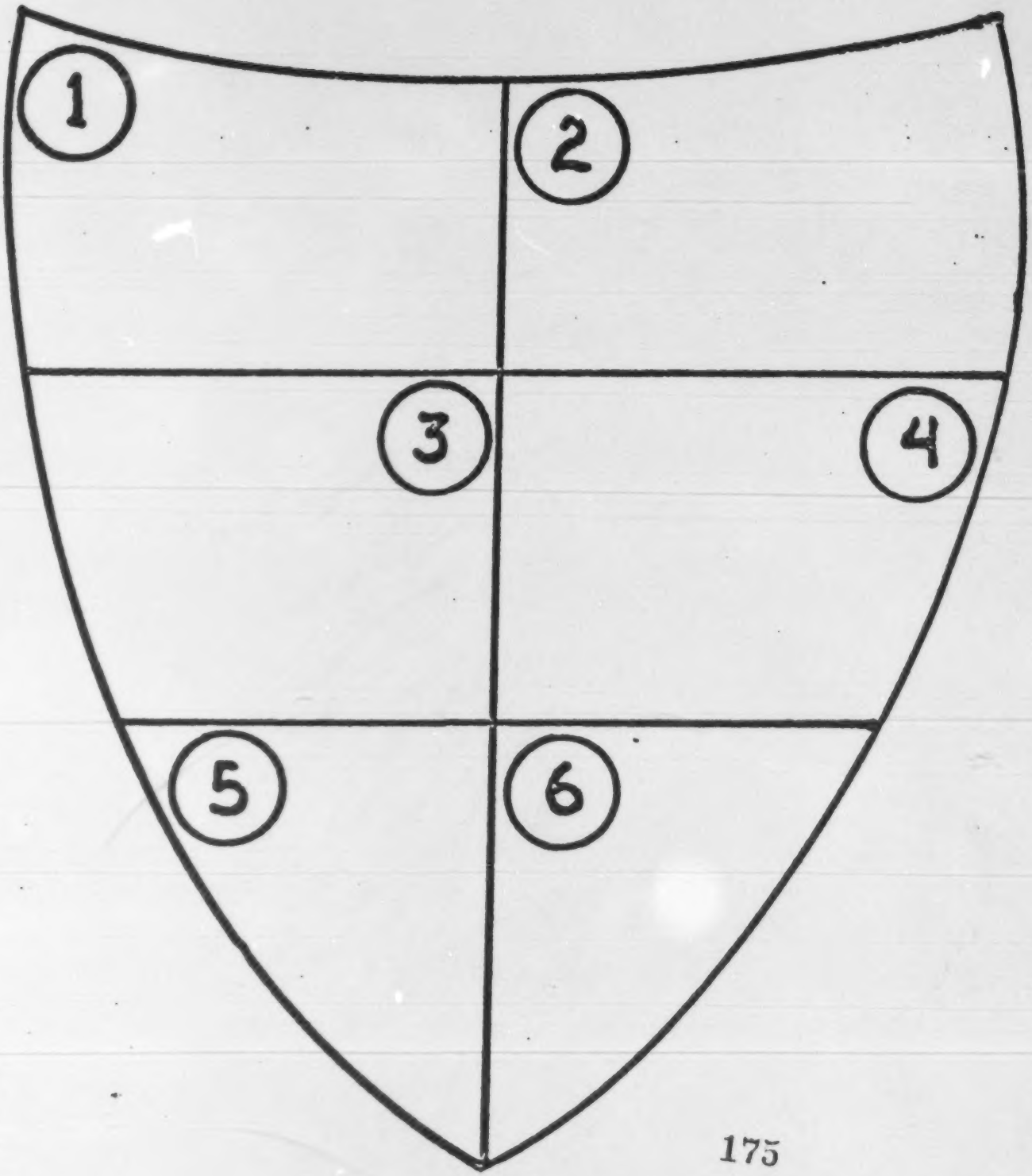
Fig. 5

Solar Dryer and Improved Food Storage Workshop

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
8						
10						
12						
2						
4						
6						

HANDOUT 17C

Coat of Arms



A Partial List of Non-Formal Education Activities

As facilitators we should be alert to using a variety of teaching methods and tools, depending upon our audience and the results we want to acheive. Learning activities/ situations can be catagorized as follows:

A. To Stimulate Interest

- Field Trips
- Role Plays: - spontaneous
  - planned
- Films or Slide Shows
- Campaigns
- Games
- Demonstrations
- Problem Dramas
- Result Demonstrations
- Puppet Shows
- Pantomime

B. To Get Discussion Going

- Picture Stores: - Closed
  - Open
  - Alternatives
- Critical Incidents
- People's Theater
- Role Plays
- Problem Dramas
- Brain Storming
- Progressive Stories

C. To Share Information

- Films/Slides
- Bulletin Board
- Displays or Exhibits
- Talks
- Puppet Shows
- Demonstrations: - Method
  - Result

D. To Build Skills

- Method Demonstrations
- Apprenticeships
- Child to Child (Neighbor to Neighbor)
- Individual "Hands On"
- Short Courses

1. These categories are not all inclusive. In fact, much overlap exists. For example, a game could be used to stimulate interest, get discussion going, to share information, or build skills.

2. All NFE activities should contemplate and encourage participation by local community members.

Some Guidelines for Motivating and Teaching Groups

Adapted from "Working with Villagers: Trainers Manual", The American Home Economics Association, International Family Planning Project, 2010 Massachusetts Avenue, N.W., Washington, D.C. 20036, USA

- Games
- Problem Dramas
- Picture Stories
- Talks "Charlas"

Games

To the Trainer: One of the ways to "change the pace" of a lesson and involve those who are shy is by having the audience play a game that relates to lesson content. This activity will help field workers understand how games can be used in their teaching and how to develop games.

Steps:

1. Explain that a game may help people see ordinary things in a new way. It may also start them talking and open them to new ideas.

   A game is good if:
   - field worker is well-organized to present the game and has tried it out with a small group first.
   - people understand the rules of the game; the field worker should announce the rules clearly before the game is started and check that everyone understands.
   - the game introduces a new idea that is important to the lesson's content.
   - as many people as possible have a chance to play the game.
   - the follow-up questions lead to a lively group discussion.

   If the field workers have used games in their teaching, as them to describe the games and their experiences in using them.

   Ask trainees to think of games villagers play. List them on the blackboard. Discuss ways these games could be adapted to specific lesson content.

Some Guidelines for Motivating and Teaching Groups

Problem Drama

To the Trainer: A problem-drama is another effective teaching technique which causes people to think and to participate in group discussion.

Discuss what makes a good problem-drama. Be certain the following points are covered:

A good problem-drama:

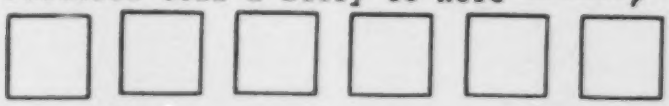
- o is based on a situation which is true to the real life of the audience.
- o is based on a problem that is important to villagers.
- o is unfinished but the narrator stops at an exciting point.
- o is controversial so that the audience will want to discuss their ideas on how the problem should be solved.
- o occurs over a short period of time.
- o does not have too many characters.
- o focuses on one major problem.
- o has follow-up questions which lead to group discussion.

Involve the participants in a discussion of possible themes for problem-dramas, themes that relate to lesson context they wish to teahc. They might recall situations involving village families which they have experienced or heard about.

Picture Stories

1. Open-ended Drama

Pictures tell a story to here ------→ Audience thinks up possible endings.

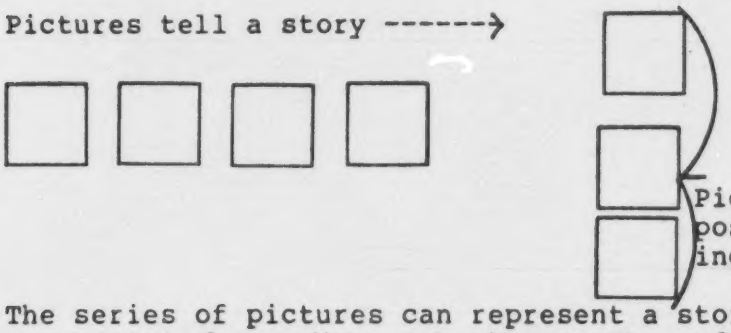


As with the problem-drama, the pictures represent the major events of a story that ends in a problem or a situation that is not completed. The audience is asked to suggest possible solutions or ways to end the story.

Some Guidelines for Motivating and Teaching Groups

2. Problem-Drama with Several Solutions

Pictures tell a story ------>

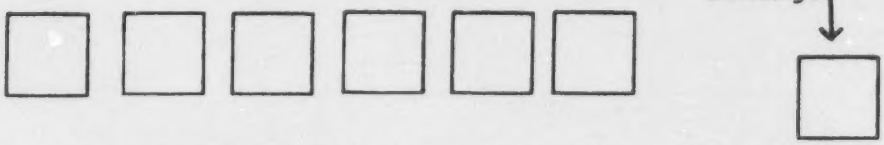


The series of pictures can represent a story ending with a variety of possible solutions. The audience is asked which solution they would choose and why.

3. Problem with a Solution

Pictures tell a story ------>

Picture shows ending.



The series of pictures present a complete story or action. The audience is asked to tell the drama as presented by the pictures and discuss their reactions to the solution. Was it right? Would they have done the same thing? Something else? Why?

Note: The questions a field worker asks with the pictures are as important as the pictures themselves.

4. Demonstrate using a series of pictures.

TRAINER'S REMINDER

Prior to this activity, select approximately 7 related pictures (of people, places or things) from your resource file, magazines or draw simple pictures on separate sheets of paper. You may think of a story these pictures could depict.

Some Guidelines for Motivating and Teaching Groups

Explain that several photographs, magazine pictures, or handdrawn pictures can be presented in a series. There are different ways in which these pictures can be used to cause people to think and share their opinions.

Ask the group to suggest ways that your series of pictures can be arrange to stimulate discussion. Ask one person to arrange the pictures and tell a story which they depict.

T A L K S:

"GIVING A TALK"

When to give a talk
1. To give Specific Information
2. To Reach a Large Group at One Time
3. To Introduce New or Unfamiliar Subjects

The talk is one teaching method in which the field worker gives information to her audience. It is a method most teachers feel comfortable with. There are several advantages in giving a talk. For example:

1. Much information can be given in a short time.
2. A large group can be reached at one time.
3. Subjects with which the audience is not familiar can be more easily presented.

However, there are also disadvantages to lectures. For example:

1. When people only <u>listen</u>, they do not remember very much.
2. A talk cannot be used for teaching skills such as how to make supplementary foods.
3. Some people who give talks think that having information about the subject is enough and do not both to make the talk interesting.

Some Guidelines for Motivating and Teaching Groups

4. The talk alone is rarely effective; it should be used with other teaching methods such as questions, visuals, discussion, etc.

A first step is planning the talk. Careful preparation before a talk is important. The following steps are helpful:

1. Gather information from books, pamphlets, extension materials. Select the material that is best for your particular audience and that directly relates to the topic and the ideas you want to teach.

2. Arrange material in the sequence you will study and present it.

3. Decide how much time you will spend on each point. If the material is too lengthy, cut it down or plan two talks on the subject.

4. Write your headings and main points on a small card which you can look at from time to time. This will help you to remember all the important points.

PREPARING A TALK

1. Gather information
2. Arrange & sequence material
3. Decide on time; keep it short
4. Write an outline; keep it short
5. Plan questions and Audio-Visuals ahead of time.

Instead of one large card, you may prefer to use smaller flash cards, one for each point.

Some Guidelines for Motivating and Teaching Groups

5. Plan questions or visual aids that will help the audience to participate and to better understand the talk.

TIPS
1. Use understandable language.
2. Be friendly.
3. Speak loudly and clearly.
4. Ask questions.
5. Summarize important points.

There are some tips that will help you to give effective talks.

- Use only language that the audience understands and uses. Be friendly.
- Speak loudly and clearly so that everyone can hear.
- During the talk, after each main point, ask the audience questions to see if they understand. If not, try to explain in a different way.
- In the conclusion of your talk, repeat the important points. Never give new material in the conclusion. Than ask the audience for questions.

Role Play Guidelines for Extension Workers

I. Designing role plays

a. depict a familiar, critical problem that is important to the target group
b. focus on one major point
c. be clear and concise
d. make believable characters, not all good or bad
e. keep the role play simple and uncomplicated
f. try making the role play controversial to make the group members want to discuss their opinions and ideas afterwards
g. identify what simple props will aid in communicating the idea

II. Conducting role plays

a. before beginning, clarify the roles of the observers
b. be the role assigned for the entire role play
c. let yourself become emotionally involved, but do not overact
d. make data up if necessary, but make sure the information is believable
e. avoid consulting the script or notes during the presentation
f. de-role after the role play if necessary (especially with spontaneous role plays)

III. Processing role plays

a. The questions asked about the role play are as important as the role play itself
b. The first questions addressed to the group should draw out <u>their</u> interpretation of what went on
c. The rest of the follow-up questions should stimulate active group discussion

IV. Applying role plays

a. An effective way to bring the processing of the role play to a close is to ask the group how they can make use of (apply) their observations and discussions of the role play.

PEOPLE'S THEATRE

Adapted From "People's Theatre as an Appropriate Media" by
Martin L. Byram Appropriate Technology Vo. 7 No. 2 September, 1980

INTRODUCTION

There is a growing concern that educational media should be used and conrolled by the people themselves rather than development experts so that it better serves their interests. Previously, technology choices in development orientated media of ten tended to emphasize expensive imports, creating dependencies on Foreign products and skills. Indigenous or people's media, on the other hand is low cost, requires no complex technical skills, and draws on the resources and creativity of the people. The cheapest and least complex of these is peoples' (village) theatre-drama, music, dance and puppetry performed by and for the people, using their language, and dealing with their issues.

People's theatre is technique used to involve communities in expressing their problems, discussing them and taking action. It provides a good draw for people who are normally bored with development meetings. As a collective expression and a communal activity it creats the context for cooperative rather than individual thinking and action. As an oral medium in local languages it involves many people who are left out of development activities because of their illiteracy or very low education level.

There is no special expertise required for peopl's theatre and local villagers are involved in all aspects of the work- identifyin g the problems to be presented, preparing and giving the performances, and working out the strategies for community action. Since the actors and initiatives come from the community, there is a greater chance that the performance will lead to action.

This form of theatre is rough and improvised. There are no long rehersals, scripts or memorized lines. The actors agree on a scenario and improvise their words and actions within this basic structure. By using people's theatre we are not only improving communication or utilizing a low-cost media, but are also building on t he cultural strength of the people and increasing their confidence and capacity in the process.

People's theatre is not designed simply to give people a chance to get their prievances and frustrations off their chest. It must lead to analysis and action.

PLANNING AND PRESENTING PEOPLE'S THEATRE

But mere expression of concerns and issues is not enough. The popular theatre programme is not designed simply to give people a chance to get their grievances and frustrations of f their chest. It must le ad to analysis and action. The theatre performance is merely the initial catalyst for an on going process of discussion, organization, and action. At the end of each performance the community meets to discuss the problems presented, to work out solutions, and organize for action.

PEOPLE'S THEATRE

This notion of people's theatre is different from the conventional concept promoted by many development groups whose view is that since folk media works(because of its legitimacy and familiarity among, the people) it should be used as a channel for development messages planned by development experts. In Botswana, on the other hand, people's theatre is used to express the people's own issues from their own perpective.

The drama provides an objective view of what is happening in the community which helps community members to stand back and look at it critically. Of course, other media have been used for similar purposes, e.g. film and video. Drama has the same immediacy as video for "playback" purposes) but it has the added advantage of using the skills and resources in the community and avoiding the technical complexity and cost of video equipment. Video has been used in Botswana but its vulnerability to bumps, dust, and other problems from rural use and the difficulties of arranging regular servicing makes it a liability rather than a useful tool.

Organizing people's theatre involves four basic stages:

a. gathering information about the community problems;
b. planning and rehearsing the performance;
c. giving the performance and organizing discussion;
d. follow-up work.

These four stages are briefly described below

Gathering Information
Two possible approaches are used to gather the information needed for the performance. One is to organize a workshop for community members during which the people meet in small groups and list all the issues and problems they feel are important. Then the whole workshop selects a few priority problems, which are chosen by looking at the following kinds of questions:-

1. What problems are people willing to take action on?
2. What are the managable tasks that people can easily do, and do not involve large investments or rely on outside support?
3. What are the problems that people themselves can do something about rather than having to depend on government action?

At the end of the workshop each group takes one of the priority problems and prepares a short skit on it. This helps to provide ideas for preparing the actual village performance.

PEOPLE'S THEATRE

The disadvantages of the workshop approach is that there is a tendency only to obtain the views of the village leaders. An alternative approach is to interview individuals and groups in the community. The purpose is the same: to allow people to talk about what they see to be the problems of the community.

Planning the performance

The first step is to list all the available information about the problems that have been selected. This includes information gathered at the workshp, or in the interviews, and from the actors' own experience. Listing what people already mow about theproblems, and discussing what it is that stops them from solving these, helps the actors to decide upon the most realistic way of presenting the problems and any possible solutions.

Once the relevant information has been listed, the actors can begin to create the performance. As a first step they have to decide what form of media to use-drama song. puppetry, or dance- to present theproblems. A combination of these might be used to reinforce the issues, for example:

- venereal Disease - song dance, drama.
- Sanitation - puppetry, dance.
- Nutrition - drama, song puppetry
- Pesticide Abuse - drama, song puppetry.

Through a process of improvisation and self-criticism a performance is constructed and rehearsed. Realism is the guiding criterion; does the performance reflect the community situation?

The performance

The performance is given at the village meeting place. A simple stage area is created by erecting a backcloth. Actors can enter or leave the stage by appearing from or disappearing behind the backcloth. The back-cloth is placed in such a position that the audience can see the performance whilst sitting in the shade. The event is publicised in advance by the village extension workers, through the village organizations, and by public notices.

There are many ways in which to present the performance. We have always encouraged the audience to join in, and explain what will be happening at the beginning. We have also made a point of tellingthe audience that there will be a disucssion after the performance. Then it begins. The actors try to keep the performance short and lively and in order to make it a more polished and enjoyable event for the audience, a few simple rules are used: only one actor speaking at a time; speaking laudly; facing the audience-; and having the props' ready. Props are kept to a minimum; a table and a chair might be used to represent a bar. for example.

Immediately after the performance, the discussion is organized. The actors move into the audience and arrange small discussion groups. The discussion focuses on what people saw in the performance and its relevance to their own village. They are encouraged to find possible soluntions to their problems. After a while the groups are brought back together to give their reports to the whole audience. An open discussion is held with an emphasis on trying to get consensus on appropriate solutions and

PEOPLE'S THEATRE

The performance helps to make people more aware of their problems. However, in a one-day performance it is difficult to provide all the detailed information and advice necessary for people to change their way of doing things. Alot of questions remain to be answered. A follow-up programme is needed to help answer these question and provide support for community action. The follow-up programme does not need to be elaborate. It may, for example, simply involve training extention workers to give factual talks, or helping villagers obtain the materials required for their community action projects. It is important, however, tha the follow-r up takes place as soon as possible after the performance.

HANDOUT 20A

Evaluation for Method Demonstration

	Acceptable	Needs Improvement
Demonstrator		
1. Appropriately dressed.		
2. Conveyed enthusiasm.		
3. Maintained eye contact with the audience.		
4. Spoke smoothly while using vocabulary directed to the educational level of the audience.		
5. The verb tenses and basic grammatical structures used permitted the demonstration to be understood.		
6. Spoke clearly the key words (verbs, technical vocabulary).		
7. Showed control over the audience.		
8. Kept to the topic of the demonstration.		
9. Appeared comfortable and self-assured in front of the audience.		
10. Greeted and said goodbye to the audience according to local customs.		
11. Demonstrated sensibility to the local culture.		
12. Presented the demonstration without using notes.		
Presentation		
13. All materials, supplies and equipment were on hand before beginning.		
14. Emphasized to the audience 3 reasons why it is important to adopt the practice to be introduced.		
15. Included the components of a demonstration in the order indicated (introduction, materiasl, procedure, summary, thank you, goodbye).		

Evaluation for Method Demonstration

	Acceptable	Needs Improvement
16. Made use of non verbal communication (visual aids, etc.).		
17. Involved the audience in the practical part of the demonstration.		
18. Understood and answered adequately the questions asked.		
19. Showed competency in the technical area of the topic discussed.		
20. The demonstration convinced you that the practice presented is beneficial.		

Planning a Method Demonstration

1. Demonstration_____

2. Why is this demonstration important to your audience?

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

3. Materials needed for this demonstration.

   a. Equipment and Supplies.

      (1) _____

      (2) _____

      (3) _____

      (4) _____

      (5) _____

      (6) _____

      (7) _____

      (8) _____

   b. Visual Aids and Handouts.

      (1) _____

      (2) _____

      (3) _____

Planning a Method Demonstration

4. Presenting the Demonstration:

STEP-BY-DEMONSTRATION	KEY POINTS

5. Summary

6. Thank you and Goodbye (handshake)

Method Demonstration Guidelines

Purpose

It is very important that you have clearly in your mind the exact purpose of your demonstration. If your purpose is not clear to you, you will not be able to communicate it clearly to someone else.

The first thing you must consider in giving a demonstration is your audience. The following is a list of questions which should be considered when planning a demonstration.

1. How large is your audience?
2. Is there an optimum size?
3. What is the audience interest?
4. What is the audience's age?
5. What is the audience's level of education?
6. How much does the audience know about the subject?

Key points:

7. If the subject of demonstration is new to the audience, can it be related to some experience or subject common to all?
8. Does implementing demonstration techniques involve financial or emotional risk to members of the audience?

Planning

Secondly, you should plan the procedure step by step to elminate confusion, keep things moving smoothly, ensure correct results and, most important of all, know your subject matter.

1. You should limit the scope of the demonstration, so that it covers only one subject, can be covered well and is not so long as to lose the attention of the audience.

2. If the demonstration is part of a series of demonstrations necessary to convey a complete idea, try to include a minimum of material connecting it to succeeding demonstrations.

3. Be sure you have all the materials and implements necessary to do the demonstration. Do not rely on people to bring a necessary implement or material when they come to the demonstration. Have it ready beforehand.

Method Demonstration Guidelines

4. Will the villager have all the tools and materials necessary to implement what you have demonstrated? If not, can you help to obtain them?

5. Be sure you can handle the tools necessary for the demonstration sufficiently well to be credible.

6. How much work is needed to adequately demonstrate the process?

7. Know all technical terms necessary for the demonstation.

8. If the demonstration is new to you, do it by yourself once to be sure of steps, problems, etc.

9. Think about ways to reinforce learning (i.e., will it be necessary to work with each person who attended the demonstration on an individual basis? A repeat demonstration?).

10. Think of ways to get people to come (for example, send word with school children, individual home visits, community notices).

11. You may want to keep a list of persons who attended the demonstration to help you remember who will need a follow-up visit and, if you are giving a series of demonstrations, to know who missed which demonstration.

<u>Visual Aids</u>

Visual aids can play an important part in a demonstration. A visual aid need not be a drawing. It can be a model, a finished product, a picture or a photo. Any visual aid used should be an integral part of the demonstration and not something which will be distracting in itself. The following are some questions to be considered when developing visual aids for a demonstration (since the meaning of "visual aids" may differ from what you intend or to what villagers understand in their culture):

1. Does the demonstration require visual aids?
2. Can something else be used more effectively?
3. Do the aids need to be drawn?
4. Should they be drawn before or during the demonstration?
5. Is the audience acquainted with visual aids?
6. Is it simple enough to be understood?

Method Demonstration Guidelines

7. Are you sure your picture conveys the message you intend in a cross-cultural situation?

Demonstration

If the demonstration has been carefully planned, the actual demonstration should go well.

1. Begin with a simple introduction, thanking the people for coming, particularly any community leader(s) present. Shake everyone's hand.

2. You may want to start the demonstration by getting the audience into a directed discussion which will lead to the realization of the need for or usefulness of that project, method or process which you are about to demonstrate.

   Make sure the participants provide or you state at least 3 reasons for adopting the new practice at the beginning of your demonstration. If they do not understand the why of the demonstration, they probably will not be very motivated to listen and participate.

3. Explain preliminary layout of materials, tools, etc.

4. Work through steps according to your plan, explaining each step as you go. This is particularly important when the steps have a specific order.

5. Have visual aids at hand so there will be no interruption while going to get them or taking the audience to a room to use the blackboard.

6. Ask if there are any questions after each step.

7. When you are finished, summarize the procedure.

8. Offer to help all the participants when they try what you have demonstrated. Set a specific date for individual help if the person shows sufficient interest.

9. Thank the people again for attending the demonstration. Do a farewell handshake.

Use of Vegetable Oils to Protect Stored Beans from Weevil Attack

Adapted from Journal of Economic Entomology, April, 1978, pp. 254-256, volume 71. number 2 by A.V. Schoon Hoven.

ADDRESS: Centro International de Agricultural Tropical
Apartado Aero 6713 Cali, Colombia

Ancient Indian methods protected stored pulses (beans) from weevil attack by using vegetable oils. Cow peas treated with groundnut oil (5-10 milliliters per kilogram) protected seed up to 6 months while preserving germination. The thin oil layer is believed to block oxygen supply to the embryo of this storage pest.

Vegetable oils were tested to protect stored dry beans, Phaseolus Vulgaris L., against attack by a weevel, Zabrotes Subfasciatus. This pest and some other weevils affix their eggs to the seed coat within a protective cover. Different vegtables oils (African palm, cotton seed, maize, soy bean, peanut, or coconut palm) when mixed at the rate of 5-10 milliliters per kilogram of see all provided some control for over 75 days, in this test. African palm oil and crude cotton see oil gave nearly complete protection at the 5 milliliter per kilogram of seed treatment level. Manual mixing of oil gave significantly less protection than mechanical tumbler mixing (35 rpm for 5 minutes). Apparently, manual mixing did not completely cover the seed with an oil layer.

Germination of beans treated with different oils remained equal to that of Malathion treated beans over the 6 month test period.

It should be noted that crude oils are not only cheaper than refined oils, but also contain more antioxidants, which delay rancidity. Rancidity could be a negative side effect of oil treatments on taste. These oil treatments are non-toxic, preserve seed germination and are simple and inexpensive to apply by the small farmer or consumer.

NOTE: 5-10 milliliters per kilogram is equal to 1/2 to 1 teaspoon per pound.

Evaluation Checklist for Dryers and Stores

_____ Compare to the local method for:

- Quality
- Simplicity
- Ease of Use

_____ Culturally acceptable? (Meets an established need?)

_____ Large enough?

_____ Ease of maintenance?

_____ What does it cost? (What is the mix of local and imported resources used?)

_____ Design review accomplished? (Modifications to improve it; performance checks, such as air flow.)

_____ Temperatures achieve? (Right temperature range? Adequate range of vent size openings?)

_____ Simplicity? (Uses the least items to make, is understandable, does most easily the job which needs to be done?)

_____ Suits the user population? (i.e., light enough for kids or women to move if that is required?)

_____ Construction process? (How did it go? How to do it? Lessons learned? Problems/solutions? Time to build?)

HANDOUT 27A

Program Evaluation

Please rate your general satisfaction with the training program:

1. General satisfaction:

1	2	3	4	5
Not Satisfied at all				Extremely Satisfied

2. Have your expectations been met? Why or why not?

3. Which session proved most useful?

4. Which session was not useful?

5. Do you have any specific feedback for any of the trainers?

6. What has gone well?

7. What hasn't gone well?

Handout 27B

APPROPRIATE TECHNOLOGY
INFORMATION AND RESOURCE LIST

Information Collection & Exchange
Office of Multilateral and Special Programs
ACTION/Peace Corps
806 Connecticut Ave. N.W.
Washington, D.C. 20525
(for program and training hournals, and appropriate technology information)

Farallones Institute Rural Center
15290 Coleman Valley Road
Occidental, CA 95465

Farallones Institute Urban House
1516 5th Street
Berkeley, CA 94710
(plans, drawings, publications, info)

Aprovecho Institute
359 Polk Street
Eugene, OR 97402
503-929-6925

Community Environmental Council
924 Anacapa St., Suite B4
Santa Barbara, CA 93101
(drawings, publications, info)

Institute for Local Self-Reliance
1717 18th St., N.W.
Washington, D.C. 20009
(charts, drawings, publication, info)

New Alchemy Institute
237 Hatchville Rd.
East Falmouth, MA 02536
(info and monthly journal)

Appropriate Technology International
1724 Massachusetts Ave. N.W.
Washington, D.C. 20036
202-293-9270
(funding & info for Third World groups)

Hesperian Foundation
P.O. Box 1692
Palto Alto, CA 94302
415-327-4576
(Health & self-help info)

INFORMATION WITH PUBLICATIONS
Newsletters and books

Volunteers in Technical Assistance
1815 N. Lynn St. Suite 200
Arlington, VA 22209
(monthly newsletter, technical assistance service & VITA Village Technology Handbook in Spanish and English)

Appropriate Technology Project
Volunteers in Asia
Box 4543
Stanford, CA 94305
(excellent Appropriate Technology Sourcebook to get you to what you are looking for)

Intermediate Technology Development Group
9 King St.
London WCQE 8HN
ENGLAND
(quarterly Journal of Appropriate Technology - if you only have one to subscribe to, this is it! and publications list on everything you can imagine)

International Association for the Advancement of Appropriate Technologies for Developing Countries
University of Michigan
603 East Madison
Ann Arbor, MI 48109
313-764-6410
(monthly journal called Approtech)

Transnational Network for Appropriate Technologies (TRANET)
P.O. Box 567
Rangeley, ME 04970
(excellent networking and ideas-oriented newsletter)

Vecinos Mundiales/World Neighbors
5116 North Portland Avenue
Oklahoma City, OK 73112
(quarterly magazine in both Spanish and English; excellent for material on work you might do in community development)

Brace Research Institute
McDonald College of McGill University
Ste. Anne de Bellevue, P.Q.
HOA 1CO Canada
(lots of technical information)

Canadian Hunger Foundation
75 Sparks Street
Ottawa, Ontario
KIP 5A5 Canada
(last two groups have jointly published
A Handbook in Appropriate Technology)

Technical Assistance Information Clearinghouse
(TAICH)
200 Park Avenue, South
New York, N.Y. 10002
(newsletter on world issues)

Whole Earth Truck Store
558 Santa Cruz Avenue
Menlo Park, CA 94025
(bibliography list and mail order of anything, alomst!)

Handout 27C

Descriptive Bibliography of Solar Dryers and Storage Devices

A. Solar Dryers

1. A Survey of Solar Agricultural Dryers - Report T99, Dec. 1975.

   This Survey contains the history, use, plans and drawings of solar dryers from throughout the world. Locally designed and built dryers are of special interest. Full of technical data and useful drawings and plans.

2. Preserving Food by Drying. A Math/Science Teaching Manual (Manual #M-10)

   A very good teaching manual for people involved in education at the junior high or high school level. Describes the physics of solar energy design and the physiology of dryed foods, health and nutrition.

3. Proceedings of the Solar Dryer Workshop, Manila, Philippines, 1978.

   Focus of this book is the drying of foods in humid tropical regions of the world. More technical, less practical.

B. Drying and Storage

1. Postharvest Food Losses in Developing Countries.

   An excellent book describing food losses and how to control them. Complete with photographs of improved storage devices from around the world. Focus on using low-cost improvements which utilize local materials and resources.

2. Small Farm Grain Storage

   A complete manual on solar dryers, back-up heaters, improved storage devices, and enemies of stored grain. Good information on control of insects and rodents. Full of clear drawings, charts, and plans.

3. Village Technology in Eastern Africa

   Focus on improving health and nutrition of women and children through the use of appropriate technologies. Short section on solar dryers and improved food storage devices.

C. Grain Storage

1. Appropriate Technology for Grain Storage

   Report of one village dealing with their food storage problems in 8 weeks using the dialogue approach to community development. Focus on improving local grain storage techniques using simple, low-cost, locally designed and built devices.

2. Programming and Training for Small Farm Grain Storage

Complements Small Farm Grain Storage, with focus on methods of taking that information to farms and rural areas.

3. Handling and Storage of Food Grains in Tropical and Subtropical Areas #12, Hall, D.W., 1975, 2nd Ed., Food and Agricultural Organization of the United Nations, Rome, ITALY

An excellent, detailed and highly technical handbook on storage of food grains, from small-scale to large scale. Full of useful information for trainers, agriculturalists and extension workers.

Solar Drying and Improved Food Storage Bibliography

1. SOLAR DRYING IN THE TROPICS, Meals For Millions/Freedom From Hunger Foundation, P.O. Box 680, Santa Monica, CA 90406, USA

2. SUN DRYING YOUR FRUITS AND VEGETABLES, United States Department of Agriculture, Washington, D.C., USA.

3. PRESERVING FOOD BY DRYING, Peace Corps, Information Collection and Exchange, 806 Connecticut Ave., NW., Washington, D.C. 20526, USA.

4. APPROPRIATE TECHNOLOGY FOR GRAIN STORAGE, 1976, Economic Development Bureau, 234 Colony Road, New Haven, CT 06511, USA.

5. PROCEEDINGS OF THE SOLAR DRYING WORKSHOP, Manila, Philippines, October 18-21, 1978, Bureau of Energy Development, Ministry of Energy, Fort Bonifacio, Makita, Metro Manila, PHILIPPINES.

6. SURVEY OF SOLAR AGRICULTURAL DRYERS, Technical Report T 99, Brace Research Institute, MacDonald College of McGill University, Ste Anne de Bellevue, Quebec, CANADA H9X 3MI.

7. PUTTING FOOD BY, Hertzberg, R., Stephen Greene Press, Box 1000, Brattleboro, VT 05301, USA.

8. SMALL SCALE GRAIN RAISING, Logsdon, G. Rodale Press, Emmaus, Pennsylvania, USA.

9. VILLAGE TECHNOLOGY IN EASTERN AFRICA, UNICEF, Eastern Africa Regional Office, P.O. Box 44145, Mairobi, KENYA.

10. FOOD PRESERVATION, RURAL HOME TECHNIQUES, Vol. 5, FAO, Economic and Social Developnent Series, FAO, Rome, ITALY.

11. MANUAL OF IMPROVED FARM AND VILLAGE-LEVEL GRAIN STORAGE METHODS, Dichter, D & Assoc., 1978.

12. HANDLING & STORAGE OF FOOD GRAINS IN TROPICAL AND SUBTROPICAL AREAS, Hall, D.W. 1975, 2nd Ed. Food and Agricultural Organization of the United Nations, Rome, ITALY.

13. POST HARVEST FOOD LOSSES IN DEVELOPING COUNTRIES, U.S. National Academy of Sciences, 1978.

14. SMALL FARM GRAIN STORAGE, Peace Corps Information Collection and Exchange, 806 Connecticut Ave., NW., Washington, D.C. 20525, USA.

15. SOLAR FOOD DRYER, Rodale Plans, 33 East Minor St., Emmaus, PA 18049.

16. PROGRAMMING AND TRAINING FOR SMALL FARM GRAIN STORAGE, PC ICE, 806 Connecticut Ave., NW. Washington, D.C. 20526

17. LOW TEMPERATURE ANI SOLAR GRAIN DRYING HANDBOOK, Midwest Plan Service. Iowa State University, Ames, IA 50011, USA.

18. POSTHARVEST GRAIN LOSS ASSESSMENT METHODS, American Association of General Chemists, St. Paul, MN, USA.

Technical Solar Dryer Design Information

This handout is intended for those who would like more technical information on the design of solar dryers. Technical information is given in a step-by-step method, showing how an enclosed solar dryer can be designed and built for any crop under any climate condition by showing many examples. This handout refers to and complements other handouts in the Participant's Notebook, especially Handouts 2A, 2B, 5B, 5C, 6A, 13A, 13B and 13C. The following acts as a decision-making flowchart, reference guide as well as a table of contents.

Before you begin to design a solar crop dryer, you need to decide on the crop to be dried and the weight of the crop to be dried at one time. Then follow these steps:

Step A, How to find percent moisture, wet basis

Step B, How to find the weight of water that needs to be removed from your crop

Step C, How to find out how much air has to pass through your crop to dry it

Step D, How to find the volume of air from the weight of air

Step E, How to find the flow rate through the dryer

Step F, How to find the area of solar collector needed

Step G, How to figure vent area needed

Then compile this information into a rough plan, model or design, evaluate it for cost, simplicity, feasibility, etc. and either build it or re-design it, repeating the above procedures, using different numbers (i.e., try drying less grain, or pre-dry your crop by air-drying, or install a fuel-fired, rainy season dryer, etc.)

Technical Solar Dryer Design Information

Step A

How to find percent moisture (M), wet basis:

$$M = \frac{100\%\ (w-d)}{w}$$

Where:

M = percent moisture

w = weight of wet sample

d = weight of dry sample

*dry = oven dried at 222°C (450°F) for 48 hours

Example:

10kg of fresh maize weighs 8kg when dry

w = 10kg

d = 8kg

$$M = \frac{100\%\ (10-8)}{10} = \frac{100\%(2)}{10} = 20\%$$

Step B

How to find out how much water (m_w) must be removed from your crop:

Use the formula:

$$m_w = \frac{w_i\ (M_i - M_f)}{100\% - M_f}$$

where:

m_w = mass (weight of water to be removed)

w_i = initial mass (weight) of crop to be dried

M_i = initial percent moisture of the crop

M_f = final percent moisture of the crop

Example:

How much water must be removed from 100kg of groundnuts in reducing the initial moisture of 26% to the final moisture of 14%?

Substituting:

$$m_w = \frac{100kg\ (26-14)}{100 - 14}$$

$$= \frac{100 \times 12}{86} = 14\ kg$$

Technical Solar Dryer Design Information

Step C

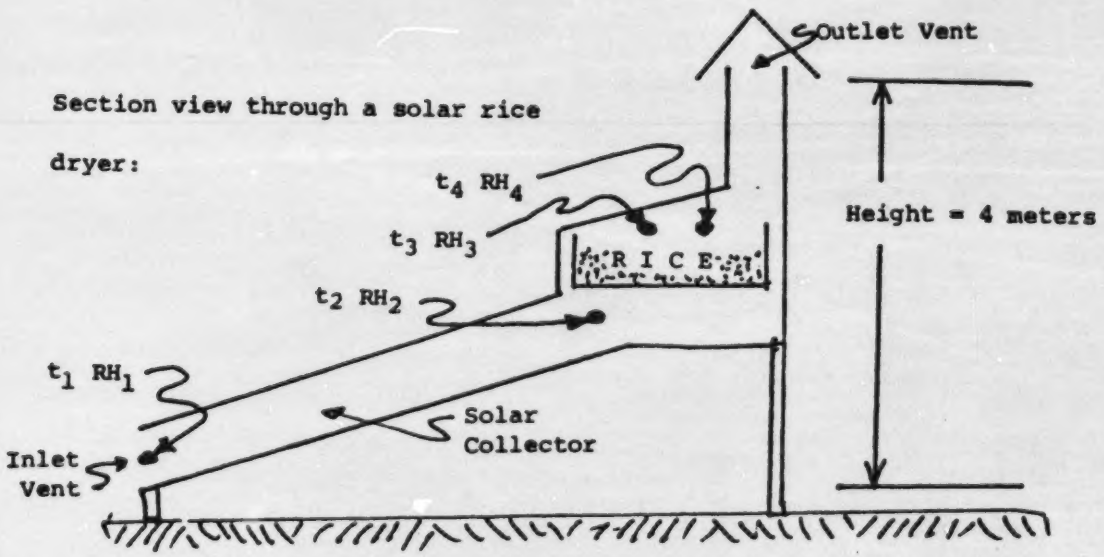
How to find out how much air has to pass through the crop to dry it.

There are two methods:

1. using the psycrometric chart, and
2. using the energy balance equation.

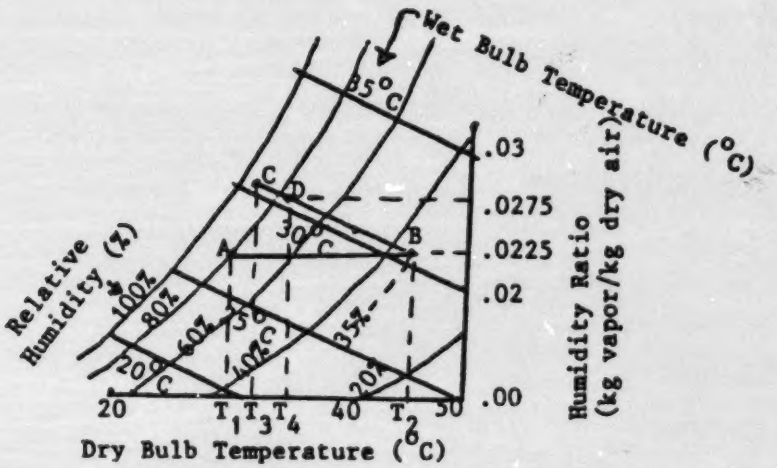
Step C1 - Using the psychrometric chart

Example: You want to dry one kilogram of rice from initial moisture content of 22% to the final moisture content of 14% using the dryer shown:



Technical Solar Dryer Design Information

The ambient air temperature (t_1 in the diagram) is 30°C and the relative humidity (RH_1 in the diagram) is 80%. Ambient air is shown as Point A on the sample psychrometric chart:



As the ambient air (Point A) is heated in the solar collector (pre-heater) part of the dryer, the air heats to 45°C (t_2) and the relative humidity drops to 35% (RH_2), which is Point B on the psychrometric chart. The path A - B represents the heating of the air in the solar collector, keeping a constant humidity ratio and so moving parallel to the dry bulb temperature axis. As the heated air passes through the rice, it picks up moisture from the rice and cools down, moving along the curve of the wet bulb temperature. Initially, when the rice is quite wet, the air picks up a lot of moisture from the rice. This increases the relative humidity (95% = RH), and lowers the temperature to 31°C (to t_3), which is Point C on the psychrometric chart.

Technical Solar Dryer Design Information

Later, as the rice becomes drier, the air picks up less mosture from the rice and its relative humidity (75% = RH_4) does not increase as much and the temperature (35°C, t_4) does not drop as much. This is Point D on the psychrometric chart. The humidity ratio rose from 0.0225 (Point B) to 0.0275 (Point D). The difference (0.0275 - 0.0225 = 0.005) is the amount of water (kg water vaper per kg of dry air) carried away from the grain by the air.

The equilibrium moisture content (EMC) (see Handout 13B) of the rice at Point C can be found in Table 1, "The Equilibrium Moisture Content of Rough Rice, Per Cent Wet Basis": t_3 =31°C and RH_3 = 95%. By interpolating and extrapolating the figures in Table 1, Point C has an EMC of 18% (which is still too high for one year's safe storage).

The EMC for Point D (t_4 = 34°C and RH_4 = 75%) can be interpolated from Table 1 and found to be 14% (which is the desired final moisture content and the moisture content for one year's safe storage).

Table 1: Equilibrium Moisture Content* of Rough Rice, Per Cent Wet Basis

Dry Bulb Temperature (°C)	Relative Humidity of Air (%)							
	20	30	40	50	60	70	80	90
10	8	9	11	12	13	14	16	19
20	7	9	10	11	13	14	15	18
30	7	8	9	11	12	13	15	17
40	6	7	8	10	11	12	14	17

* Equilibrium Moisture Content is the moisture level at which rough rice will stabilize when exposed to the temperature and relative humidity levels shown.

Technical Solar Dryer Design Information

The amount of water to be extracted from 1kg of rice in this case can be figured using the equation found in Step B of this handout:

$$m_w = \frac{W_i (M_i - M_f)}{100\% - M_f} \quad \text{Here, } m_w = \frac{1\text{kg } (22\% - 14\%)}{100\% - 14\%} = 0.093\text{kg}$$

From the definition of Humidity Ratio (weight of water vapor in the air to the weight of dry gases in the same air), it follows that the mass of air needed (m_a) in this case, where Humidity Ratio rose by 0.005, is:

$$m_a = \frac{0.093 \text{ kg water}}{0.005 \frac{\text{kg water vapor}}{\text{kg of dry air}}} = 18.6\text{kg of dry air}$$

We can transform this weight of dry air (m_a) to volume (V) with the equation from Step D of this handout: $PV = m_a R t$

Where P = 101.3 kPa (normal barometric pressure at sea level), and

$t = 308^{o}K$ ($35^{o}C$, $^{o}K = 273 + {}^{o}C$), and

$m_a = 18.6$ kg, then

$$V = \frac{m_a Rt}{P} = \frac{18.6 \times .291 \times 308}{101.3} = 16.5 \text{ m}^3$$

Technical Solar Dryer Design Information

Step C2 Using the Energy Balance Equation

The Energy Balance is an equation that expresses the following idea mathematically: The energy available from the air going through the food inside a dryer should be equal to the energy needed to evaporate the amount of water to be removed from the crop.

The task in solar dryer design is to calculate and then achieve optimum temperature (t_f) and air flow (m_a per time) to remove the specified amount of water (m_w).

The formula is: $m_a C_p (t_i - t_f) = m_w L$

Where:

m_a = mass (or weight) of the drying air

C_p = Specific Heat Capacity of Air

C_p = Amount of heat air can hold per degree of its temperature rise.

C_p varies a bit with humidity and temperature, but use 1.02 KJ/kg^{o}C

EXAMPLE:

How much more heat energy (E) can be held if the temperature of 3kg of air rises from 35 to 40^{o}C?

E = 1.02 KJ/kg^{o}C x 3 kg x (40-35)

= 1.02 x 3 x 5

E = 15.3 KJ (KJ = kilo Joule. 1 KJ = 1 BTU = 0.25 Kcal)

t_i = initial (or ambient, or inlet) temperature

t_f = final (or outlet, or maximum) temperature (see Handouts 2A and 13C)

m_w = mass (or weight) of water to be removed by evaporation (see Step B)

Technical Solar Dryer Design Information

L = Latent Heat of Vaporization of water

L = amount of energy needed to vaporize (evaporate) each unit (gram, pound, etc.) of water from the crop.

For free water in an open pan, L = 2,400 KJ/kg (KJ = kilo Joules, a measure of energy). For water from crops, it's a bit more because the water has to be extracted from the crop. L also varies with temperature and moisture content, but use the amount 2,800 KJ/kg in your calculations.

We have calculated above (using the formula from Step B) that the amount of water to be removed (m_w) = 0.093 kg. We know the two constants, L = Latent Heat of vaporization = 2,800 KJ/kg, and C_p = Specific Heat of Air = 1.02 KJ/kg^{o}C.

Assuming initial temperature (t_i) = 45^{o}C and the final temperature (t_f) = 32^{o}C, we can substitute into the Energy Balance Equation:

$(m_a C_p (t_i - t_f) = m_w L)$

to get:

$$m_a = \frac{m_w L}{C_p (t_i - t_f)} = \frac{0.093 \times 2,800}{1.02 \quad (45-32)} = 19.6 \text{ kg of air}$$

We can translate this figure to m^3 using the Rule of Thumb from Step D: (1 kg o f air = 0.9 m^3 or $PV = m_a Rt$ and we get 17.3 m^3 of air.

Notice that this result (17.3 m^3 of air) is not identical to the 16.5 m^3 of air calculated in Method Number 1, using the Psychrometric Chart. However, the results are close enough for solar dryer design work.

Technical Solar Dryer Design Information

Step D

How to figure volume (V) of air from weight (m_a)

Air is usally quantified by its volume (V), pressure (P) and temperature (t).

Use the formula: $PV = m_a R t$

Where:

P = Pressure (in kiloPascals, or kPa)

V = Volume (m^3)

t = temperature (^oKelvin, or ^oK) ($^oK = 273 + ^oC$)

m_a = mass (weight) of air

R = A constant factor, equal to 0.291 kPa $m^3/kg\ ^oK$

Example:

What is the volume of 1kg of air at 300^oK (27^oC) and barometric pressure of 101.325 kPa?

Substituting: $101.325 \times V = 1\ kg \times 0.291 \times 300^oK$

$$V = 87.3/101.325 = 0.86\ m^3$$

(The Rule of Thumb is that the volume of 1kg of warm air (35^oC or 308^oK) and normal pressure (P = 101.325 kPa) is 0.9 m^3. Notice how the volume of air changes slightly with temperature and relative humidity on the psychrometric chart.

Technical Solar Dryer Design Information

Step E

How to figure air flow rate:

Example:

We want to dry 1,000kg of rice. We know, from Step C, that it takes approximately 17 m^3 of air per kg of rice, so for 1,000kg, we will need 17,000 m^3 of air total. If we assume it will take four days to dry the grain at 7-1/2 hours of sunshine per day, this air will take 30 hours to flow through the grain, which is:

$$\frac{17{,}000\ m^3}{30\ \text{hours}} = 566.67\ m^3/hr = 9.44\ m^3/\text{minute}$$

Step F

How to figure area of solar collector needed:

Use the formula:

$$A = \frac{\text{Total Energy Required}}{\text{Energy Available}} = \frac{m_w \times L \times K}{Q \times E \times D}$$

Where:

A = Area of solar collector needed, (m^2)

m_w = mass (weight) of water to be evaporated
(0.093 $\frac{\text{kg water}}{\text{kg grain}}$ x 1,000kg grain = 93kg)

L = latent heat of vaporization = 2,800 KJ/kg

K = a constant to convert from kJ to MJ = 1 MJ/1,000 kJ

Q = the daily insolation rate = 15 MJ/m^2 day

E = the efficiency of the solar collector = 25%

D = number of days = 4 (from step E)

Notes: *MJ = mega Joule = 1,000,000 Joules = 1,000 kilo Joules = 1,000 kJ
*Typical insolation rates range from 5 - 25 MJ/m^2 day, but use 15 MJ/m^2 day

Technical Solar Dryer Design Information

$$A = \frac{\text{Total Energy Required}}{\text{Energy from solar collector}} = \frac{93 \text{ kg} \times 2{,}800 \frac{\text{kJ}}{\text{kg}} \times \frac{1 \text{ MJ}}{1{,}000 \text{ kJ}}}{\frac{15 \text{ MJ}}{\text{m}^2 \text{ day}} \times 25\% \times 4 \text{ days}}$$

$$A = \frac{260.4 \text{ MJ}}{15 \text{ MJ/m}^2} = 17.36 \text{ m}^2$$

Step G

How to figure vent area (two methods)

Method 1

If you have the required flow rate already figured (see Step E), then use this formula:

$$\text{Vent Area (cm}^2\text{)} = \frac{\text{air flow (m}^3\text{/min)}}{0.0004 \sqrt{\text{height (m)} \times \Delta \text{ t (}^\circ\text{C)}}}$$

Example:

Step E shows a flow rate of 9.44 m^3/minute is required to dry our 1,000 kg of rice in four days. Checking our other resources (Handouts 2A, 13C) we find that the maximum allowable drying temperature for rice for human food is 45°C. The ambient air temperature is 30°C. Change in temperature (Δ t) = 45°C - 30°C = 15°C. Assume the vertical height of the dryer is 4 meters between inlet vent and outlet vent. Substituting:

$$\text{vent area (cm}^2\text{)} = \frac{9.44 \text{ m}^3\text{/min}}{0.0004 \sqrt{4 \times 15}} = \frac{9.44 \text{ m}^3\text{/min}}{0.0004 \times 7.75} = 3{,}047 \text{ cm}^2$$

Method Number 2

If you have calculated a collector aperture (area) and have some idea of solar intensity (Insolation Rate), then use this formula:

$$\text{Vent Area (cm}^2\text{)} = \frac{\text{Hourly Insolation Rate (kgcal/m}^2\text{ hr)} \times \text{Aperature (m}^2\text{)}}{0.01 \times \Delta \text{ t} \sqrt{\text{Height (m)} \times \Delta \text{ t (}^\circ\text{C)}}}$$

Technical Solar Dryer Design Information

Assume that a maximum of 15% of the total daily radiation falls in the hottest mid-day hour (0.15 x 25 MJ/m^2 day = 3.75 MJ/m^2 hr). Converting to $kcal/m^2$ hr,

$$3.75 \frac{MJ}{m^2\ hr} \times 239 \frac{kgcal/m^2}{MJ/m^2} = 896\ kgcal/m^2\ hr$$

Use the collector aperture (A) found in Step F: A = 17.5 m^2

Let Δ t = 15°C and Height = 4 m

Substituting:

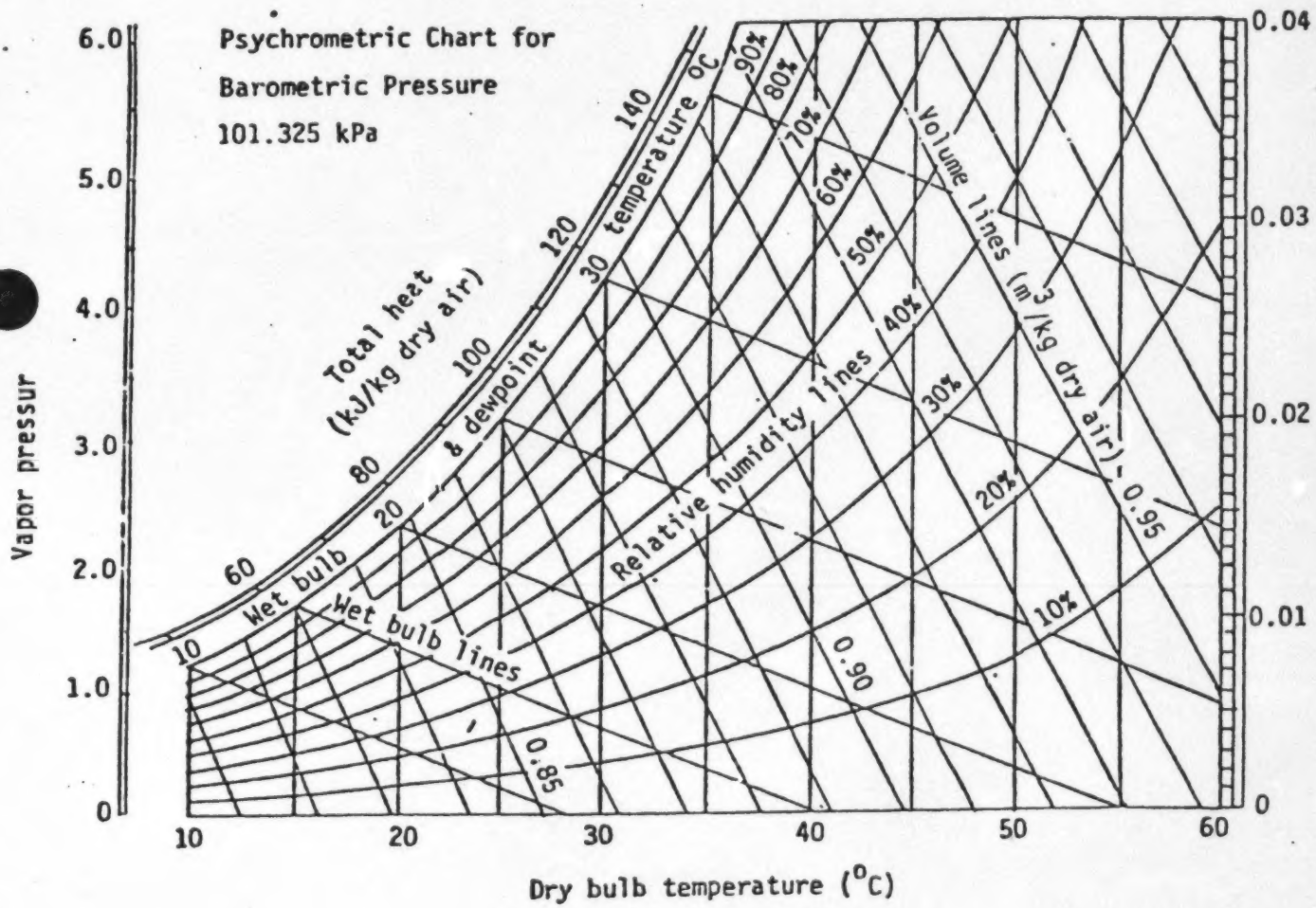
$$\text{vent area } (cm^2) = \frac{896\ Kgcal/m^2\ hr \times 17.36\ m^2}{0.01 \times 15^oC\ \sqrt{4m \times 15^oC}} = \frac{15{,}680}{0.15 \times 7.75} = 13{,}380\ cm^2$$

Note: This vent size area has been calculated using a very high insolation rate. By substituting a high insolation rate, your vents will be large enough to always prevent overheating, even under the most intense sun conditions. If the sun conditions are not at their maximum, you can always close the outlet vent to raise the internal temperature of the dryer, if necessary. (For example, with the lower insolation rate of 15 MJ/m^2 day, the vent area will only need to be 8,030 cm^2, or about half.)

THE PSYCHROMETRIC CHART

The upper curve of the chart is for saturated air and is labelled wet-bulb and dewpoint temperature. (The word "dewpoint" arose from the observation that dew forms on grass when the grass cools, by radiaiton to the sky, to a temperature equal to or less than the wet-bulb temperature of the air above it.)

The other curves on the psychrometric chart that are similar in shape to the wet-bulb line are lines of constant relative humidity (in %). By definition, relative humidity is a ratio: the partial pressure of the water vapor at a given temperature ÷ the saturation pressure of the water vapor at the same temperature. The scale at the left side of the chart gives the pressures.



The straight lines sloping gently downward to the right are lines of constant wet-bulb temperatures. The intersection of a dry-bulb and a wet-bulb line gives the state of the air for a given moisture content and relative humidity. The lines of constant wet-bulb temperature also give values of constant enthalpy (total heat content), measured in heat units per unit weight of dry air.

Other lines sloping more steeply to the right give the specific volume of dry air, the volume occupied by one kilogram of dry air under the indicated conditions.

In examining a psychrometric chart, note that:

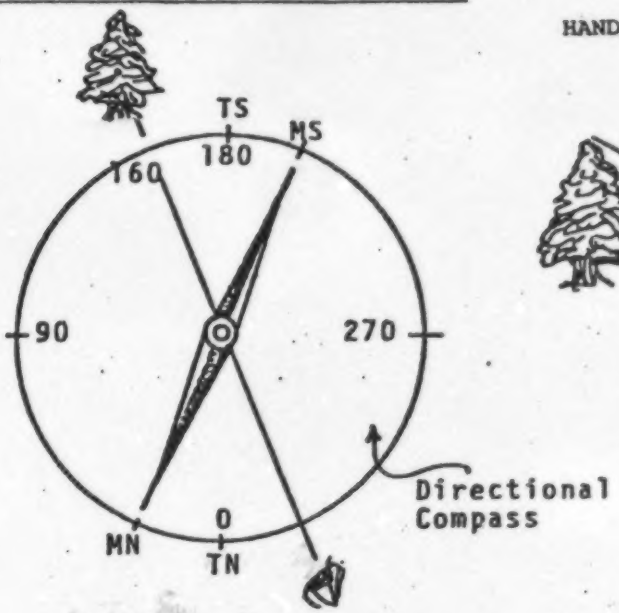
- Processes in which air is heated or cooled without change in moisture content give horizontal lines. Heating along such lines will decrease the relative humidity, while cooling will increase it.

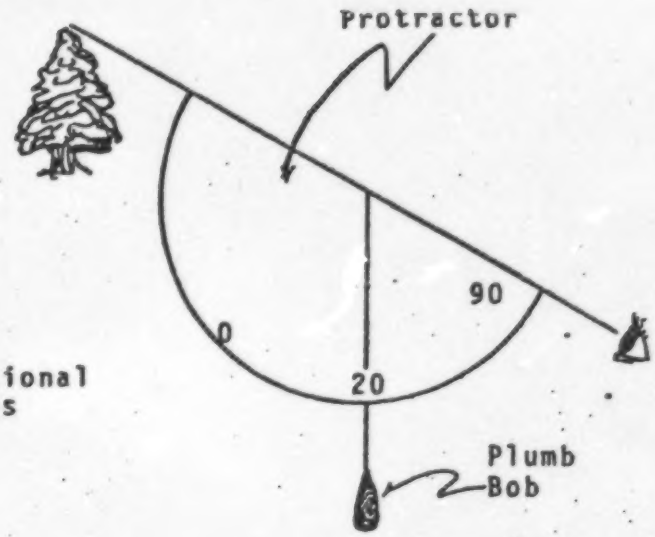
- The wet-bulb temperature lines, sloping downward to the right, are lines of adiabatic cooling (where there is no change in heat content). These lines typify drying processes in which air is passed over the surface of wet material and is cooled by evaporation of water from the material. Lines of constant total heat parallel these wet-bulb lines.

- Although no processes follow the lines giving the specific volume of dry air, these lines show that at any given dry-bulb temperature, the density of air decreases as either the temperature or the relative humidity rises.

PLOTTING AZIMUTH AND ALTITUDE

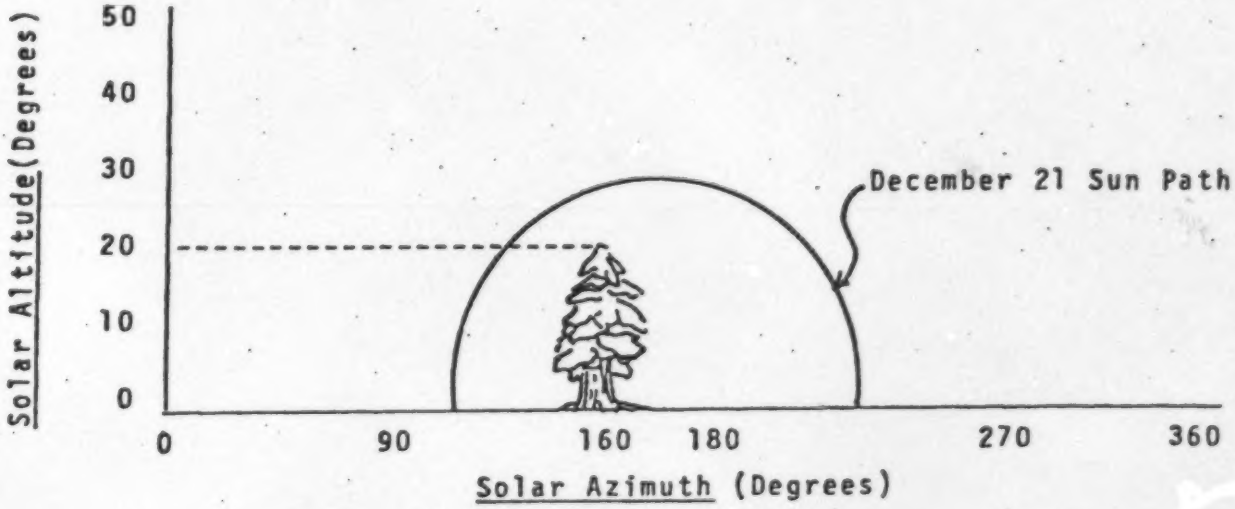
HANDOUT A2





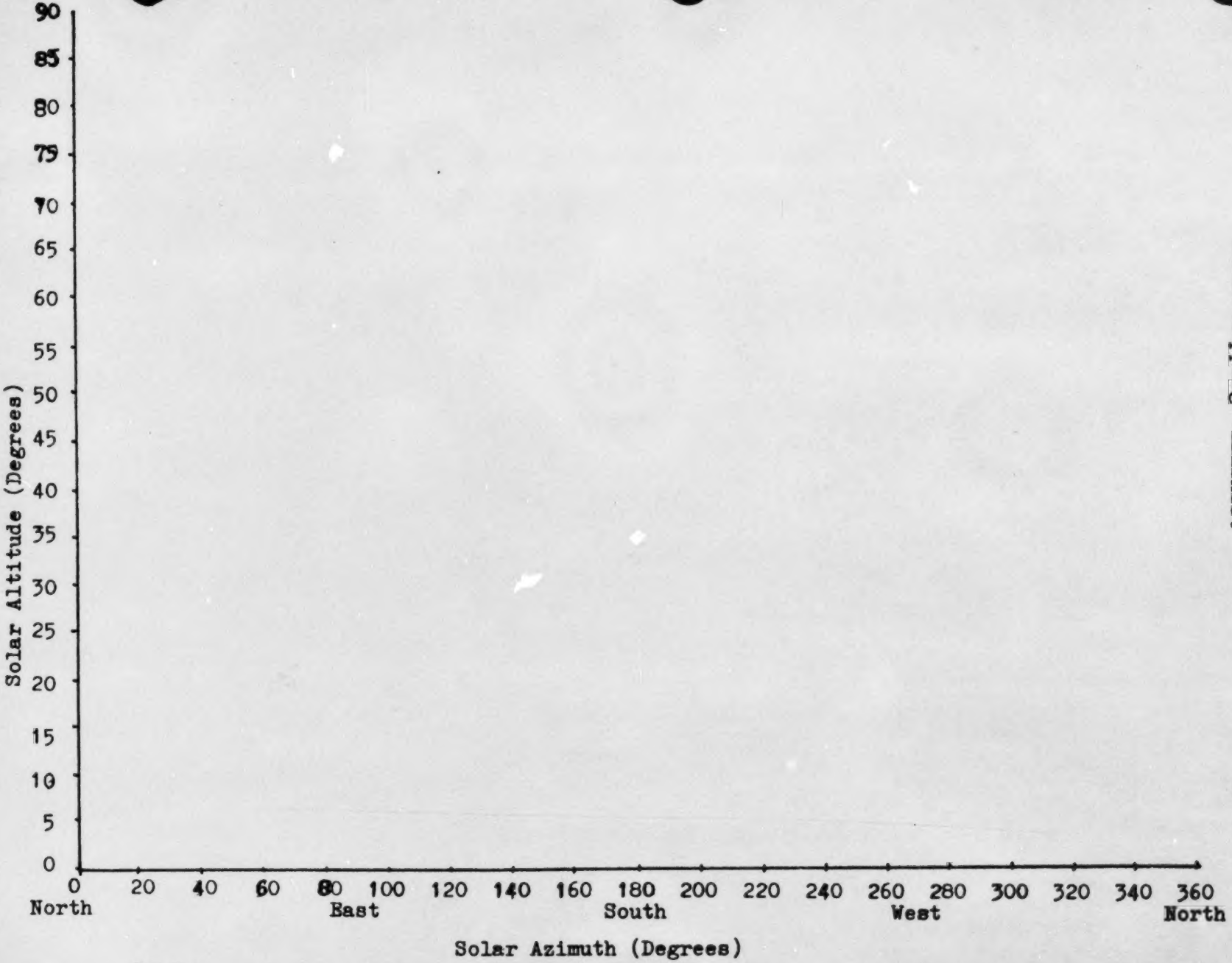
Step 1 Find the azimuth of the obstacle (tree) by lining up your eye, the center or the compass and the obstacle. Be sure the compass is corrected for magnetic variation. Read the azimuth of the obstacle, 160° in this example.

Step 2 Find the altitude by lining up your eye with the top of the obstacle along the straight edge of the protractor. The plumb bob will register the altitude, 20° in this example.



Step 3 Plot the azimuth (160° from Step 1) and the altitude (20° from Step 2) on the shade mapping worksheet as shown. If the December 21 sun path does not cross the image of the obstacle (tree), the obstacle will not shade the collector at this solar site.

Step 4 Locate all possible obstacles and plot them on the shade mapping worksheet. Analyze the data to determine if the potential solar site is actually a good solar site.

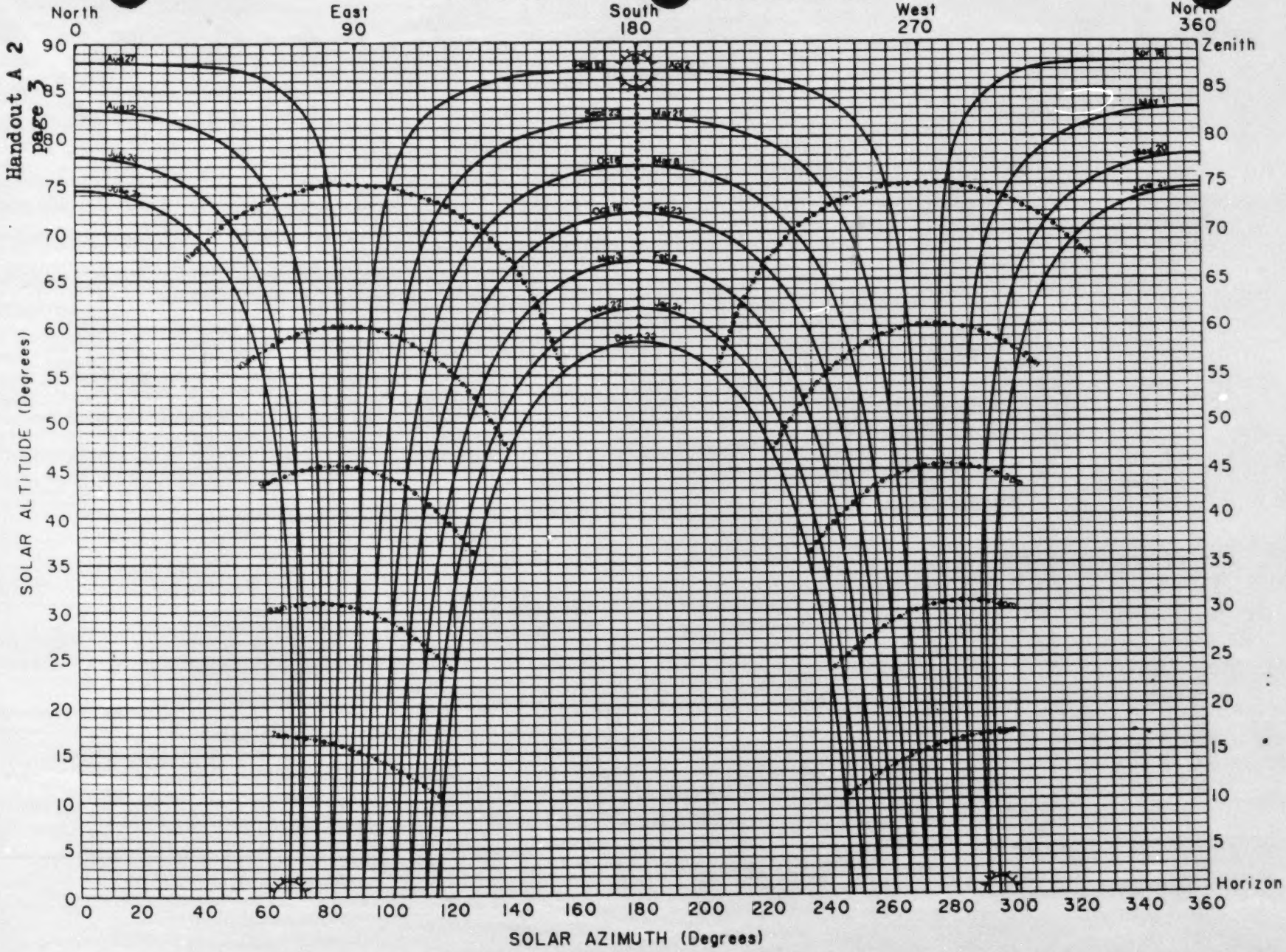


Shade Mapping Worksheet

Handout 2 A
Page 2

Handout A 2
page 3

BENNETT SUN ANGLE CHART



8° NORTH LATITUDE

THE OFPISA PROBLEM SOLVING MODEL

Buckminster Fuller said that a problem well stated is a problem solved. In order to state a problem completely and well, as much relevant information as possible must be gathered. The following model is designed to assist in the definition of the problem, the examination of all its aspects and an acceptable resolution to the conflicts and challenges presented by it.

In the model, first the original problem is stated. This may also be a goal, objective or issue.

Then, the factors relating to the problem are listed. The problem may be defined as a temporary equilibrium between factors that move toward change and those that restrain it. In order to solve the problem, the equilibrium or tension must be broken. The equilibrium may be likened to a force field: the problem is held static between opposing forces that push and pull. All factors are listed that have any bearing on the problem. One list notes the driving forces toward resolution and another notes factors that serve as restraining forces. The journalistic "w's" are useful in identifying the factors: who, what, why, where, when and how.

The problem redefined or restated is considered next. After all the factors both for and against resolution are identified, the real problem may emerge. This may be a simple restatement of the original problem or it may be another problem entirely, based on new information provided by examining the various factors.

Many and different ideas are generated by brainstorming: all ideas, suggestions and possible solutions are listed without discriminating among them. These serve to either increase the forces driving towards resolution or decrease the restraining forces. The brainstormed list may be comprised of logical, sensible ideas as well as those that seem crazy or not at all feasible. It should be remembered that most of the important or major inventions of the world had their origin in a "strange" idea that somehow worked! Therefore, judgment should be suspended during this phase and all creative suggestions listed, regardless of their initial appearance.

To devise a solution to the problem, a selection and comparison of the various ideas are made, thereby generating concrete and potentially viable solutions.

Each potential solution is evaluated to determine its acceptance by those affected by it. If the solution is not acceptable, another solution must be tried. If it is viable, then it is implemented and the problem has begun to be resolved.

One way of remembering this model is to term it the OFPISA (as in the leaning tower):

O - Original problem

F - Factors

P - Problem redefined

I - Ideas

S - Solutions

A - Acceptance

PROBLEM SOLVING WORKSHEET

O - Original Problem

F - Factors: Driving Forces Restraining Forces

P - Problem Restatement

I - Ideas

S - Solution

A - Acceptance